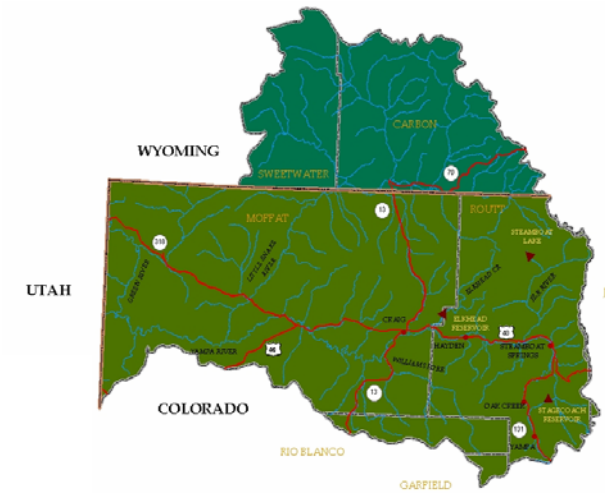
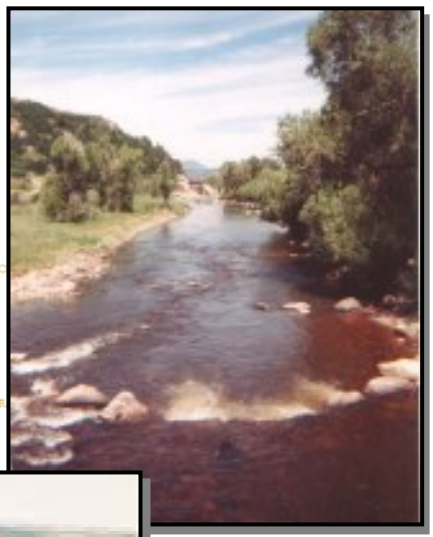
Yampa River Basin Information





June 2004

COLORADO'S DECISION SUPPORT SYSTEMS

BOYLE ENGINEERING CORPORATION

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The Yampa River basin occupies Colorado's northwest corner, rising at the Continental Divide and ending at its confluence with the Green River, within miles of the Utah border. The basin encompasses most of Routt and Moffat counties in Colorado, the upper reaches of the Little Snake River basin in southern Wyoming, and a very small area of eastern Utah. Figure 1.1 is a map of the basin. The Yampa River flows through forested mountains, rural irrigated valleys, and desert canyons within Dinosaur National Monument. Many consider the Yampa the least-impacted of Colorado's mighty rivers.

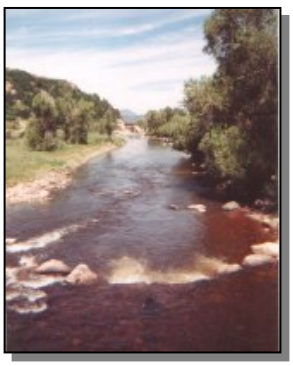
1.1. Physical geography

The Yampa River basin within Colorado is approximately 7,660 square miles in size, ranging in elevation from 12,200 feet in the headwaters near the town of Yampa to 5,600 feet in the vicinity of Dinosaur National Monument. Across this expanse, average annual rainfall varies from more than 60 inches near Rabbit Ears Pass, to approximately 10 inches near the State line. Temperatures generally vary inversely with elevation, and variations in the growing season follow a similar trend. Steamboat Springs has an average growing season of 86 days, while the growing season at Craig, Hayden, and Maybell has been estimated at approximately 120 days.

The Yampa River is the primary stream in the basin. It begins at the confluence of the Bear River and Chimney Creek, and other major tributaries include Walton Creek, Fish Creek, Trout Creek, Elk River, Elkhead Creek, Fortification Creek, the Williams Fork River, and the Little Snake River. Most of the water yield in the basin is attributable to snowmelt from the higher elevation areas near the Continental Divide. Average annual streamflow in the upper portions of the drainage (United States Geological Survey [USGS] gage near Stagecoach Reservoir) is approximately 62,000 acre-feet, which increases to an annual average of 1,623,000 acre-feet at the Dinosaur Monument (USGS gage near Deerlodge Park). Over 60 percent of this runoff occurs in May and June.

1.2. Human and economic factors

The discovery of gold near Hahn's Peak in the 1860's first drew permanent white settlers to the Yampa Valley. The mineral industry remains a key economic sector although coal and related energy activities are of greater importance than gold mining. Farming and ranching, as well as recreation and tourism, are the other primary activities in the basin today.



Yampa River in Steamboat Springs

The area remains relatively sparsely populated, with the 2000 census placing the combined populations of Routt and Moffat Counties at approximately 33,000. Steamboat Springs and Craig are the major population

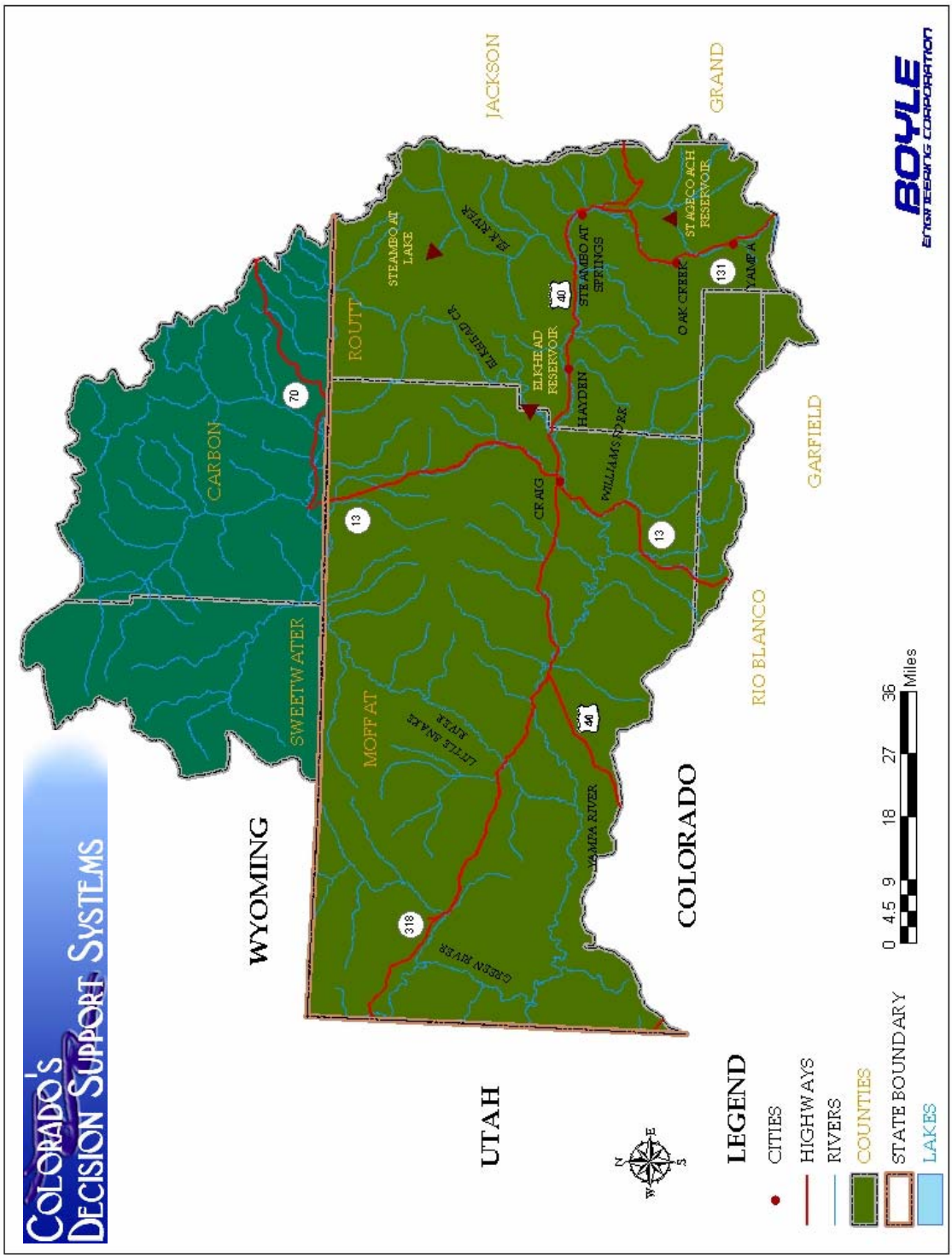


Figure 1.1 – Yampa River Basin

centers in the basin, each with just under 10,000 residents. Routt County grew by about 40 percent during the 1990's, with growth concentrated in the upper Yampa Valley near Steamboat Springs. This growth attests to the importance of recreation-based activities, as people are drawn to the basin by the ski area and other outdoor recreation opportunities.

Principal water use in the basin is for irrigation, with hundreds of small irrigation ditches diverting from the main stem and the numerous tributary streams throughout the basin. The ditches irrigate pasture and hay and alfalfa crops primarily. The total irrigated acreage in the basin within Colorado, according to the State's irrigated average assessment of year 2000 imagery, is estimated to be approximately 89,800 acres.

Other major water uses include power generation at the Hayden Station and Craig Station plants, which have historically diverted approximately 16,500 acre-feet per year. There are also diversions for municipal use in Steamboat Springs and Craig, as well as in a number of smaller towns. Technically, the largest municipal user is Cheyenne, Wyoming, which exports approximately 14,400 acre-feet/year from the Little Snake drainage in Wyoming to the North Platte basin. Within Colorado, three transbasin diversions, the Sarvis Ditch, Stillwater Ditch, and Dome Creek Ditch export water from the Yampa River basin to the Colorado River drainage. There are also a number of smaller transbasin diversions from one tributary drainage to another.

In addition to the direct ditch diversions, there are nine major reservoirs (greater than 4,000 acre-feet in capacity) in the Yampa River basin within Colorado. Three of the reservoirs are used for irrigation (Stillwater Reservoir No. 1, Allen Basin Reservoir, and Yamcolo Reservoir); three are predominantly used for recreational and fishery purposes (Lake Catamount, Pearl Lake, and Steamboat Lake); Fish Creek Reservoir serves municipal use;and the remaining reservoirs are used for multiple uses, including municipal, industrial, irrigation, and recreation (Stagecoach Reservoir, and Elkhead Reservoir). High Savery Reservoir in Wyoming will begin filling in 2004 and will serve irrigators in Wyoming.

1.3. Water resources development

The Yampa River basin has seen water resources developments in the form of private irrigation systems, municipal and industrial diversions, and State-sponsored reservoir development. Table 1.1 summarizes key developments within the basin over time.

Irrigation has remained relatively constant since the late 1800's, with only small increases in the irrigated acreage as new ditches and storage systems were constructed. The two earliest projects, Allen Basin and Stillwater Reservoirs, were built to relieve late summer irrigation shortages in the headwaters of the Bear River.

Despite a general downturn in growth and economic activity in the Yampa Valley following World War II, the 1950's saw development of the first significant municipal

system at Steamboat Springs. This downward trend in growth reversed itself in the mid-1960's, largely due to development of two large electric generating stations at Craig and Hayden, and the related resurgence of the northwest Colorado coal industry. Both the power plants use Yampa River water for cooling.

Later development reflects the rising importance of environmental and recreational uses, as well as the necessity of cooperative efforts and agreements. For example, Steamboat Lake was developed jointly by the Colorado Division of Parks and Outdoor Recreation and proponents of the Hayden Station Power Plant. Elkhead Reservoir similarly was a joint project of the Colorado Division Wildlife and the Yampa Project Participants who operate the Craig power plant. Yamcolo Reservoir was developed for irrigation, but its ability to supply water in the upper Bear River was enhanced through an exchange agreement with the multi-use Stagecoach Reservoir.

Table 1.1

Key Water Resources Developments

Date	Description
1939	Stillwater Reservoir
1956	Fish Creek Reservoir
1963	Craig Station Ditch and Pipeline
1964	Cheyenne Stage I
1965	Steamboat Lake
1974	Elkhead Reservoir
1977	Lake Catamount
c. 1979	Cheyenne Stage II
1981	Yamcolo Reservoir
1988	Stagecoach Reservoir
1996	Fish Creek Reservoir enlargement
2003	High Savery Reservoir

There are no Federal projects in the Yampa River basin, nor are there any main stem reservoirs below Steamboat Springs. During the 1950's, the Bureau of Reclamation proposed a dam at Echo Park as part of the Colorado River Storage Project, which would have inundated 46 miles of the Yampa and a comparable amount of the Green River. Controversy surrounded the region for more than a decade until a compromise was reached, in which Echo Park was foregone, and Glen Canyon Dam was built without any formal opposition.

Echo Park

1.4. Water rights administration

Historically, water right calls occur only on internally controlled tributaries where irrigation demands can exceed streamflows, such as Bear River, Fortification Creek, and North, Middle, and South Hunt Creeks. Irrigation shortages on the upper Bear River are typically satisfied by storage releases from Yamcolo and Stillwater reservoirs. On the main stem there has not been administration of water rights calls and water has been available for appropriation.

The Upper Colorado River Basin Compact of 1948 specifies that Colorado may not deplete the flow in the Yampa River below an aggregate of 5 maf over any 10-year period. Average historical consumptive use, per the Colorado Decision Support System (CDSS) Yampa River Water Resources Planning Model, is on the order of 160,000 acre-feet/year on average. Therefore the Compact constraint is not limiting at current levels of development.

Future administration of the Yampa may be affected by activities and projects in the Recovery Program for Endangered Fish. Under the Endangered Species Act, four Colorado River native fish species are listed as endangered: Colorado pikeminnow (a.k.a. Colorado squawfish), humpback chub, bonytail chub, and razorback sucker. In 1988, the States of Colorado, Utah, and Wyoming, water users, hydropower customers, environmental organizations, and federal agencies developed a program to recover these species while allowing water use to continue and up to 50,000 acre-feet/year of new consumptive use to be developed.

The Recovery Program determined that 7,000 acre-feet of augmentation would satisfy adopted base flow recommendations for the Yampa River in all but the driest 10% of years. Eleven augmentation water supply alternatives were examined in detail, as described in the *Management Plan for the Yampa River Basin*. Alternatives include purchase or lease of water from one or more existing reservoirs and/or new or enlarged reservoirs, as well as supply interruption contracts. The Colorado Water Conservation Board (CWCB) recommends adoption of an alternative developed in August 2000 by a workgroup in Craig, Colorado. The specific elements of that alternative are as follows:

- Lease up to 2,000 acre-feet per year from Steamboat Lake.
- Enlarge Elkhead Reservoir to provide 3,700 acre-feet per year for late summer releases for endangered fish.
- The balance of augmentation (1,300 acre-feet) would likely be provided through a lease between the Recovery Program and Colorado River Water Conservation District (River District). This volume could be provided from the proposed human use pool at Elkhead and/or from a new tributary reservoir.

The Programmatic Biological Opinion (PBO) will not cap the amount of water that can be developed in the Yampa Basin. Rather, it will protect the right to develop a certain amount of water within a timeframe, whose impacts can be scientifically analyzed using

the best available data. Implementation of the Recovery Program should allow Colorado to fully develop its entitlement to water under the compact.

2. Yampa River Projects and Special Operations

This section contains information that was gathered during initial data collection efforts for the CDSS project, in 1994 and 1995. It was assembled after interviewing Division 6 personnel, as well as project owners and operators. The first seven sections relate to specific diversions, and the remaining sections describe reservoirs:

Section	Description
2.1	Stillwater Ditch
2.2	Sarvis Ditch
2.3	Other Transbasin Diversions
2.4	Snowmaking Diversions
2.5	Key Municipal Water Systems
2.6	Colorado Utilities Ditch and Pipeline (Hayden Station)
2.7	Craig Station Ditch and Pipeline
2.8	Stillwater Reservoir No. 1
2.9	Yamcolo Reservoir
2.10	Stagecoach Reservoir
2.11	Allen Basin Reservoir
2.12	Lake Catamount
2.13	Fish Creek Reservoir
2.14	Steamboat Lake
2.15	Elkhead Creek Reservoir
2.16	Lester Creek Reservoir (Pearl Lake)

2.1. Stillwater Ditch

The Stillwater Ditch (a.k.a. the Five Pines Mesa Ditch) is a major diversion facility in the upper reaches of the Bear River and is operated by the Stillwater Ditch and Reservoir Company. The ditch diverts its supply from the outlet works of Yamcolo Reservoir and delivers a portion of the water for irrigation in the area of Five Pines Mesa, which is tributary to the Bear (Yampa) River basin and a portion out-of-basin to the Egeria Creek

drainage which is tributary to the Colorado River. The following absolute direct flow water right is associated with the Stillwater Ditch.

WDID	Adjudication Date	Appropriation Date	Administration No.	Amount
584685	6-08-1910	9-23-1903	22071.19623	30.83 cfs

The Company also owns Gardner Park Reservoir (WDID 583511) and Rams Horn Reservoir (WDID 583532) which are located on tributaries of the Bear River and which are used to supplement late season irrigation. The ditch also has a junior (1964), conditional water right that is owned by the Upper Yampa Water Conservancy District (UYWCD) in anticipation of a future enlargement of the ditch.

In addition to these owned storage reservoirs and direct flow right, the Stillwater Ditch is also used to deliver storage water owned by various individuals in the Stillwater Reservoir No. 1, Yamcolo Reservoir, and Stagecoach Reservoir, the latter by exchange through Yamcolo Reservoir. The Division 6 engineer estimated in 1987 that approximately 2,520 acres are irrigated under the Stillwater Ditch, with about 1,722 acres (68 percent) in the Yampa River drainage and 798 acres (32 percent) in the Colorado River drainage (Egeria Creek). These percentages would apply to all diversions made pursuant to the direct flow water right in the ditch and any storage releases delivered through the ditch from Gardner Park Reservoir and Rams Horn Reservoir. (The CDSS 1993 irrigated land mapping shows a larger amount of land under the ditch and the split between Yampa basin and Colorado basin at 72 and 28 percent respectively.) All deliveries to the Colorado River drainage represent a 100 percent depletion to the Yampa River system. Review of detailed diversion records provided by the water commissioner indicated close agreement with this relative apportionment of the diversions under the direct flow right. Storage water delivered through the ditch from Stillwater Reservoir No. 1, Yamcolo Reservoir, and Stagecoach Reservoir is owned by specific individuals with land under the ditch. Using records provided by the water commissioner, which reflect the historical delivery of storage water from each of these reservoirs, the deliveries can be apportioned between the two river basins in the following approximate percentages. Note that these percentages are different from the percentages that would be derived based solely on storage ownership and the locations of the acreage. However, use of the historical delivery records is believed to best represent actual irrigation practices under the Stillwater Ditch system.

Reservoir	Percent To Yampa River Basin	Percent To Colorado River Basin
Stillwater Reservoir No.1	58 percent	42 percent
Yamcolo Reservoir		
Yamcolo Irrigators Assn.	53 percent	47 percent
Stagecoach Contract Water	90 percent	10 percent

Refer to the documentation for Stillwater Reservoir No. 1, Yamcolo Reservoir, and Stagecoach Reservoir for additional information concerning the operation of these reservoirs.

2.2. Sarvis Ditch

The Sarvis Ditch (WDID 584684) is a transbasin diversion facility that diverts water from the headwaters of Service Creek into the headwaters of Red Dirt Creek, a tributary of Muddy Creek in Irrigation Division 5. The structure holds the following direct flow water right:

WDID	Adjudication Date	Appropriation Date	Administration No.	Amount
584684	3-30-1964	5-24-1911	39254.22423	43 cfs

The diversion is reported to be a low embankment constructed around a large open meadow near the top of the drainage divide and is located at an extremely remote sight. There is minimal regulation of the diversions and the records of diversion are, for the most part, jointly estimated by the water commissioners for Water Districts 58 and 50. It is our understanding that diversions by the Sarvis Ditch are not driven by a demand for irrigation water in the Red Dirt Creek drainage, but rather are dependent only on the physical supply available for diversion. Although the accuracy of the diversion records may be less than desirable, they are believed to be the best information available.

2.3. Other Transbasin Diversions

There are three other diversion structures within the Yampa River basin that divert water from one drainage basin to another. These structures are carrier ditches that deliver water from one tributary basin for use in another tributary basin, although they are not necessarily tied to specific irrigated acreage.

The Coal Creek Ditch (WDID 580589) diverts water from Coal Creek, a tributary of the Bear River, just downstream of Yamcolo Reservoir. It also diverts storage water from Yamcolo and Stillwater Reservoir No. 1 by exchange (water is released from the reservoirs and a like amount is diverted at the ditch headgate on Coal Creek). The ditch carries the water into the headwaters of Moody Creek where it is rediverted by several direct flow water rights on that small tributary.

The Rich Ditch (WDID 574629) diverts water from Trout Creek in Water District 57 for irrigation in the Oak Creek drainage in Water District 58. According to the water commissioner, it is treated as an import to Oak Creek and the water is then re-diverted by several direct flow rights on this stream.

The Allen Basin Supply Ditch (WDID 580506) is a feeder ditch which diverts from Mill Creek, a side tributary of South Hunt Creek, to fill Allen Basin Reservoir, located on Middle Hunt Creek. Although decreed for 60 cubic feet per second (cfs), the ditch diverts relatively small quantities of water during the spring runoff, prior to the more senior water rights on South Hunt Creek calling for water.

2.4. Snowmaking Diversions

There is one diversion for making artificial snow in the Yampa River basin, at the Steamboat Springs Ski Area. At the time of the primary snowmaking diversions, typically during the months of October, November, December, and January, the diversions represent 100 percent depletion to the Yampa River streamflows. During the winter and spring months, a portion of the artificial snowpack is consumptively used through the processes of sublimation and evaporation. Then during the subsequent spring snowmelt, the remaining portion of the artificial snow returns to the stream as an accretion.

The Steamboat Ski and Resort Corporation owns a direct flow water right for snowmaking purposes which it diverts from an alluvial well adjacent to the Yampa River, just upstream of Steamboat Springs. This structure (WDID 582374) was decreed on December 31, 1981 for 8.0 cfs. It carries an appropriation date of January 12, 1981 (Administration No. 47859.00000). The Ski Corporation also has made application for a conditional water right for an expansion of the snowmaking system. This application (also for 8.0 cfs) is pending.

According to records obtained from the Ski Co., the annual water use for snowmaking has averaged about 275 acre-feet per season, on the following schedule:

October	November	December	January	TOTAL
15	110	120	30	275

The consumptive loss attributable to the artificial snow pack is estimated to be about 20 percent, based on procedures developed for Colorado Ski Country USA. The return flows are expected to occur during the peak snowmelt season, in April and May.

2.5. Key Municipal Water Systems

The city of Craig diverts the majority of its municipal water supply at the Craig Water Supply Pipeline (WDID 440581), a pumped diversion in the Yampa River, just upstream from the mouth of Fortification Creek. To provide a reliable reserve water supply for future growth and extreme dry year conditions, the city acquired the storage water rights in Elkhead Creek Reservoir from the Colorado Division of Wildlife (CDOW). This represents approximately 1,668 acre-feet of water in storage which can be released as necessary to offset shortages after use of the direct flow right.

The city of Steamboat Springs and the Mt. Werner WSD divert the majority of their municipal water supplies from the Fish Creek Municipal Intake (WDID 58 0642). A number of senior direct flow irrigation water rights have been changed and transferred to this structure for municipal uses. The two entities share the diversion structure and water treatment facilities. According to city personnel, the direct flow rights are generally sufficient to satisfy the demand through the end of July. At that time, the physical supply in Fish Creek begins to decrease and it is necessary to supplement the direct flow diversions with water released from storage in Fish Creek Reservoir. The two entities can

also divert water from alluvial wells adjacent to the Yampa River, although this is not a preferred source because of a lesser water quality. These wells are also relatively junior and it is probable that they may eventually be included in an augmentation plan utilizing storage water from Yamcolo and/or Stagecoach reservoirs as the replacement source. Fish Creek Reservoir is owned by the city and it is our understanding that Mt. Werner has contractual rights to a portion of the storage water. The reservoir recently underwent an enlargement that more than doubled its capacity from 1,842 acre-feet to 4,042 acre-feet.

The city and Mt. Werner also own contract storage water in Yamcolo Reservoir (100 acre-feet for Steamboat and 300 acre-feet for Mt. Werner) and in Stagecoach Reservoir (552 acre-feet for Steamboat and 200 acre-feet for Mt. Werner). These storage supplies are intended for future growth and would generally be used after use of storage in Fish Creek Reservoir.

2.6. Colorado Utilities Ditch and Pipeline (Hayden Station)

This structure (WDID 570512) diverts water from the Yampa River for industrial use at the Hayden Station power generation facility. The following absolute water rights are owned by the Hayden Station Partners (Public Service Co., PacifiCorp, and the Salt River Generating Co.) for diversion through the structure:

WDID	Adjudication Date	Appropriation Date	Administration No.	Amount
570512	4-24-1959	8-12-1926	35987.27982	27 cfs
	9-01-1960	8-01-1897	36295.1738	3 cfs

Although decreed for 30 cfs, the diversion for Hayden Station is typically in the range of 6 to 10 cfs, as reflected by the historical diversion records maintained by the division engineer. The water demands are a function of the power generation, climatic conditions (air temperatures) and the Plant Capacity Factor, a factor which reflects the typical outages and downtime (both scheduled and unscheduled) for the generating units. Based on information provided by Tri-State and Public Service Co., the historical water use at Hayden was determined and is summarized in Table 2.1.

Table 2.1

Historical Power Generation and Water Use

Hayden Station Units 1 and 2

Year	Energy Production (GWHR)	Water Diversion (acre-feet)	Acre-feet/ GWHR[1]	Capacity Factor
1985	3,118	4,935	1.58	79.8 percent
1986	2,962	4,689	1.58	75.8 percent
1987	3,463	5,687	1.64	88.6 percent
1988	2,976	5,215	1.75	76.2 percent
1989	3,295	5,837	1.77	84.3 percent
Avg.	3,163	5,273	1.66	80.9 percent

[1]*GWHR = Gigawatt-hour*

There are also storage decrees for several on-site, off-stream reservoirs integral to operation of the Hayden Station power plant. The majority of the diversions to storage in these reservoirs is reflected in the historical diversions from the Yampa River through the Colorado Utilities Ditch and Pipeline. The Hayden Station Partners also own a contract right for 5,000 acre-feet of storage in Steamboat Lake which can be released for industrial use at Hayden Station. Historically, there has not been a need to utilize this back-up storage reserve. Refer to the documentation describing Steamboat Lake for more information on this agreement.

2.7. Craig Station Ditch and Pipeline

This structure (WDID 440522) diverts water from the Yampa River for industrial use at the Craig Station power generation facility. The following absolute water rights are owned by Tri-State and the other Yampa Project Participants (the operating consortium for Craig Units 1 and 2):

WDID	Adjudication Date	Appropriation Date	Administration No.	Amount
440522	03-30-1964	09-30-1961	40815.0000	45.70 cfs
	12-31-1974	11-01-1972	45290.44865	44.93 cfs

The first water right listed was transferred from the Wessels Canal, a conditional water right that was originally decreed for diversion in the vicinity of what is now Stagecoach Reservoir. As a term and condition of that transfer, the amount diverted at the Craig Station is limited to the amount of water physically and legally available at the original point of diversion. This right carries the same priority date as the senior storage decree for Stagecoach Reservoir (the Bear Reservoir decree for 11,614 acre-feet). Pursuant to a 1992 Agreement between the UYWCD and Tri-State, the use of the Wessels direct flow right was granted priority over the Bear Reservoir storage decree at times when there is

not enough water to satisfy both rights. A portion of the Wessels direct flow water right remains conditional.

The second priority decreed to the Craig Station Ditch and Pipeline is the water right that has normally been used for industrial diversions at the facility at times when the Wessels water right is limited because of the physical streamflow at Stagecoach Reservoir, as described in the previous paragraph. It is, however, a relatively junior water right which could be subject to partial curtailment in the event of strict administration of water rights in dry years, in particular during the late summer and early fall months.

It should also be noted that the Yampa Project Participants also own a contractual right to divert the more senior direct flow water right decreed to the Synthetic Products Ditch (WDID 440779) for power generation at Craig Station (Units 1 and 2). At this time 26.84 cfs of the 60 cfs decreed to the Synthetic Products Ditch have been made absolute, with 25.84 being usable at Craig Station:

WDID	Adjudication Date	Appropriation Date	Administration No.	Amount
440779	09-01-1960	09-17-1951	37149.0000	26.84 cfs

Tri-State also owns conditional direct flow water rights in the Four Counties Ditch No. 3, which rights are currently the subject of a pending application to make a portion of the right (30.32 cfs) absolute.

From the above description, it is noted that Craig Station currently has about 90.63 cfs of absolute water rights decreed for diversion at the Craig Station Ditch and Pipeline, with another 30.32 cfs pending being made absolute from conditional. An additional 25.84 cfs associated with the Synthetic Products Ditch is also divertible at this structure, giving a total of 116.47 cfs absolute and another 30.32 cfs pending absolute status. This stacking of water rights is necessary because of different ownership interests in the existing three generating units at Craig Station and because of diversion limitations contained in some of the transfer decrees.

The actual physical diversion capacity for the Craig Station Ditch and Pipeline is approximately 46 cfs, the capacity of the existing pump facilities. Historically, the diversions at Craig Station (with all three units in operation) have averaged about 15 to 16 cfs, with daily diversion rates of up to 45 cfs. The water demands are a function of the power generation at the plant, climatic conditions and the plant capacity factor for the generating units. Using information obtained from Tri-State and W. W. Wheeler & Associates, the historical energy generation and water use at Craig Station was developed and is summarized in Table 2.2.

Table 2.2

Historical Power Generation and Water Use

Craig Station Units 1, 2, and 3

Year	Energy Production	Water Diversion (acre-feet)	Acre-feet/ GWHR[1]	Capacity Factor (GWHR) (acre-feet)
1985	6,469	10,637	1.64	58.4 percent
1986	5,911	9,416	1.59	53.4 percent
1987	7,084	9.071	1.28	64.0 percent
1988	8,255	12,622	1.53	74.6 percent
1989	8,749	12,320	1.41	79.0 percent
1990	8,531	12,982	1.52	77.0 percent
1991	8,162	11,756	1.44	73.7 percent
Avg.	7,594	11,258	1.49	68.6 percent

[1]*GWHR = Gigawatt-hour*

Tri-State and the other Yampa Project Participants also own significant storage reserves, intended to ensure the reliability of the water supply for the Craig Station. Specifically, the Yampa Project Participants own 8,754 acre-feet of the storage in Elkhead Creek Reservoir and Tri-State owns 4,000 acre-feet of storage in Yamcolo Reservoir and 7,000 acre-feet of storage in Stagecoach Reservoir According to the respective ownership interests and internal agreements for the operation of the Craig Station facilities, the Elkhead Reservoir water is intended for supplemental supply to Craig Units 1 and 2, the Yamcolo water is reserved for Craig Unit 3 and the Stagecoach water can be used for all three units, if needed.

In 1992, Tri-State negotiated a water management plan with the United States Fish and Wildlife Service to provide a level of protection for the Yampa River streamflows downstream of the Craig Station diversion. This management plan affects only the use of the Wessels Canal water right for power generation at Craig Unit 3 and does not impact the operations of the other water rights or the uses at Units 1 and 2. The management plan requires that when the flow of the Yampa River, as measured at the Craig stream gage, is less than the negotiated target flow levels during the months of August, September, and October, Tri-State will forego diversions under the Wessels direct flow water right. When this target flow restriction applies, Tri-State will instead use up to 2,000 acre-feet of storage water from its Yamcolo Reservoir account to satisfy the remaining demands of Unit 3. The adopted target flow rates are as follows:

Table 2.3

Target Flows Restricting Use of Wessels Right

Month	Target Flow	Monthly Equivalent
August	150 cfs	9,223 acre-feet/month
September	110 cfs	6,546 acre-feet/month
October	115 cfs	7,071 acre-feet/month

2.8. Stillwater Reservoir No. 1

Stillwater Reservoir No. 1 (WDID 583540) is the most upstream of the major reservoirs in the Yampa River (Bear River) drainage. It is owned by the Bear River Reservoir Co. and is used to provide supplemental irrigation water supplies to a number of individuals served by several of the major direct flow structures in the upper Bear River. The reservoir has a decreed capacity of 6,392 acre-feet and carries an appropriation date of January 9, 1935 (State Administration Number = 33782.31054), making it one of the most senior storage decrees in the Yampa River basin. Although it is reported that the outlet for the reservoir is at the bottom of the reservoir, the reservoir company and the water commissioner consider the active storage to be approximately 5,175 acre-feet. This is further evidenced by the reservoir shareholder list which allocates 5,175 acre-feet among 22 shareholders. One share is considered to be equal to one acre-foot of storage. An elevation-capacity table was obtained from the Division 6 engineer who also provided a regression equation relating the reservoir water surface area as a function of the reservoir capacity:

Surface Area = 7.0*(Capacity)^0.35

According to the historical observed storage contents of the reservoir and interviews with the water commissioner, it appears that the reservoir can fill to its capacity in average and above average runoff years, but does not fill in below average years, largely because of limited physical supply in the tributary basin above the reservoir and in part, because of high loss rates through the reservoir dam embankment. Because it is the highest reservoir in the system, the water commissioner informally attempts to store as much of the available runoff as possible in Stillwater Reservoir No. 1, on the assumption that if the lower reservoirs do not fill in priority, releases can be made from the Stillwater Reservoir to satisfy unfulfilled storage downstream. During the summer irrigation season, the Water Commissioner normally sets the release from Stillwater Reservoir No. 1 at a relatively constant rate of flow and then regulates the deliveries to the various shareholders using the storage in the downstream Yamcolo Reservoir.

Because of its remote location, the outlet is normally closed in the fall and the reservoir is allowed to store all inflow during the winter (although there may be very little gain in storage because of seepage losses being approximately equal to the inflow during the winter months). After the reservoir has achieved it maximum possible fill in the spring, the available storage is allocated among the shareholders pro rata to their ownership interest. According to the water commissioner, the reservoir company has implemented an informal rule that each shareholder can carry over no more than 40 percent of his reservoir water remaining in storage on September 30 of each year, the remainder being available for reallocation to all shareholders the following year.

Using reservoir and ditch ownership data provided by the water commissioner, the individually owned storage accounts in Stillwater Reservoir No. 1 were grouped according to the ditch structures which serve the irrigated land owned by those individuals. The active storage in the reservoir is approximately allocated to the following ditch structures:

Ditch Structure	Structure ID	Storage Allocation (acre-feet)
Acton Ditch	580500	242
Big Mesa Ditch	580539	444
Bird Ditch	580541	125
Buckingham Mandall	580564	374
Coal Creek Ditch	580589	435
Fix Ditch	580643	81
Hernage & Kolbe	580684	82
Lindsey Ditch	580738	394
Mandall Ditch	580763	386
Mill Ditch No. 1	580777	81
Pennsylvania Ditch	580821	50
Stillwater Ditch	584685	2,331
Town of Yampa	580954	100
No Structure in Model	N/A	50
TOTAL		5,175

Based on historical delivery information provided by the water commissioner, diversion of storage water from Stillwater Reservoir No. 1 into the Stillwater Ditch (WDID 584685) is approximately 58 percent to the Yampa River drainage and 42 percent to the Colorado River drainage (see previous discussion for the Stillwater Ditch). Deliveries to the Colorado River (via Egeria Creek) are 100 percent depletive to the streamflow of the Yampa (Bear) River.

2.9. Yamcolo Reservoir

Yamcolo Reservoir (WDID 584240) is owned and operated by the UYWCD and is used to provide supplemental irrigation water supplies to the critically water short reaches of the upper Yampa River (Bear River). According to an elevation-area-capacity table obtained from the UYWCD, the total capacity of the reservoir at the spillway is approximately 9,096 acre-feet and the capacity at the invert of the outlet works (dead storage) is approximately 1,068 acre-feet, resulting in an active capacity of approximately 8,028 acre-feet. This same area capacity data was used by the Division 6 engineer to develop a regression equation relating the reservoir water surface area to the reservoir capacity:

Surface Area = 3.05*(Capacity)^0.46

The UYWCD has obtained the following absolute decrees for the storage in Yamcolo Reservoir:

WDID	Adjudication Date	Appropriation Date	Administration No.	Amount (acre-feet)
584240	03-30-1964	02-26-1963	41329.00000	6,532
	05-30-1972	06-29-1959	41727.39991	2,500
	12-31-1980	09-04-1951	47481.37136	1,000
	12-31-1990	02-27-1981	51134.47905	314
TOTAL				10,346

The second priority for 2,500 acre-feet was transferred to Yamcolo Reservoir from the water rights originally decreed to the Pleasant Valley Reservoir, a large reservoir that was planned for a site near the present day location of Lake Catamount. Note that the total storage decrees are in excess of the active storage capacity in the reservoir.

The active storage in Yamcolo Reservoir was originally allocated by the UYWCD by assigning 1,010 acre-feet for municipal uses; 3,000 acre-feet to the Yamcolo Irrigators Association for irrigation in the upper reaches of the Bear River; and 4,000 acre-feet to Colorado-Ute Electric Association (Tri-State's predecessor), for industrial uses. The dead storage of approximately 1,086 acre-feet is reserved for a conservation pool.

The municipal water is held by the following entities. Historically, there has been very little use of this water.

Name of Municipality	Amount of Reservoir Storage (acre-feet)
Town of Hayden	300
Morrison Creek WSD	60
Mt. Werner WSD	300
Routt County & Phippsburg	50
Town of Steamboat Spring	100
Town of Yampa	200
TOTAL	1,010

The Yamcolo Irrigators Association currently consists of about 18 individuals who irrigate land under several of the major ditch structures in the upper Bear River. Using reservoir account and land ownership data provided by the water commissioner, the reservoir accounts were grouped according to the structures that are used to serve the irrigated land owned by those individuals.

Structure	Structure ID	Storage Allocation (acre-feet)
Acton Ditch	580500	50
Big Mesa Ditch	580539	500
Bird Ditch	580541	300
Buckingham Mandall	580564	87
Coal Creek Ditch	580589	300
Egeria Ditch	580622	100
Fix Ditch	580643	113
Hernage & Kolbe Ditch	580684	62
Lindsey Ditch	580738	550
Mandall Ditch	580763	138
Mill Ditch No. 1	580777	62
Stillwater Ditch	584685	513
Wooley Ditch	580945	50
Lake Catamount	N/A	75
Misc. small structures	N/A	100
TOTAL		3,000

Pursuant to a 1992 agreement between the UYWCD and Tri-State, the UYWCD may store in and deliver from Stagecoach Reservoir the 4,000 acre-feet of water to which Tri-State is entitled annually from Yamcolo Reservoir, and may store in the 4,000 acre-feet of the Yamcolo Reservoir capacity originally allocated to Tri-State, 4,000 acre-feet of water allocated to agricultural users from Stagecoach Reservoir. This exchange arrangement effectively increases the agricultural water supplies in Yamcolo by another 4,000 acre-feet and moves all of Tri-State's industrial water into Stagecoach Reservoir. Currently the 4,000 acre-feet of Stagecoach Contract Water, deliverable by exchange through Yamcolo Reservoir, has been contracted for by individuals with land under the following ditch structures:

Structure	Structure ID	Storage Allocation (acre-feet)
Acton Ditch	580500	165
Buckingham Mandall	580564	100
Egeria Ditch	580622	100
Hernage & Kolbe Ditch	580684	100
Mandall Ditch	580763	100
Stillwater Ditch	584685	
Colorado Basin		343
Yampa Basin		3,092
TOTAL		4,000

The allocation of Stagecoach water to the Stillwater Ditch (90 percent to the Yampa and 10 percent to the Colorado) is based on historical delivery information provided by the water commissioner. The apportionment also agrees closely with the ownership of the Stagecoach contract water. Delivery of water to the Colorado River basin (via Egeria

Creek) should be considered as 100 percent depletive to the streamflow of the Yampa River.

Among the three general accounts in Yamcolo Reservoir, the municipal account has the senior priority with respect to filling its 1,010 acre-foot account; the Yamcolo Irrigators Association has the second priority to fill its 3,000 acre-foot account and the Stagecoach Contract water has the last priority of fill during years when the reservoir cannot fill because of insufficient physical supply.

2.10. Stagecoach Reservoir

Stagecoach Reservoir is the largest storage facility in the Yampa River basin and is also owned and operated by the UYWCD. The reservoir is intended to provide supplemental industrial, agricultural, and municipal water supplies as well as a significantly sized conservation pool for recreational purposes. According to an elevation capacity table obtained from the UYWCD, the total capacity of the reservoir at the spillway elevation is approximately 33,275 acre-feet and the capacity at the invert of the outlet works (dead storage) is approximately 3,275 acre-feet, resulting in an active capacity of about 30,000 acre-feet. The Division 6 engineer provided a regression equation relating the reservoir water surface area to the reservoir capacity:

Surface Area = 0.84*(Capacity)^0.65

The UYWCD has obtained the following absolute decrees for storage in Stagecoach Reservoir:

WDID	Adjudication Date	Appropriation Date	Administration No.	Amount
584213	03-30-1964	09-93-1961	40815.00000	11,614 acre-feet
	05-30-1972	06-29-1959	41727.39991	20,854 acre-feet
	03-30-1964	06-02-1958	39599.00000	86 cfs

Additional discussion is warranted in regard to the water rights used at Stagecoach Reservoir. The first storage right for 11,614 acre-feet was part of the former Wessels Project and shares the same priority date as the Wessels Canal, which is owned in part, by Tri-State for direct flow industrial use at the Craig Station. Pursuant to a 1992 agreement between UYWCD and Tri-State, the UYWCD's storage decree is subordinated to the priority of Tri-State's Wessels Canal flow right, to the extent that there is insufficient flow for both. Note that diversions on the Wessels Canal water right at Craig Station are limited to the amount legally and physically available at its original headgate location just downstream of Stagecoach Reservoir.

The second storage right is part of the 40,720 acre-foot, conditional storage decree that was transferred from the former Pleasant Valley Reservoir site, which is now the location of Lake Catamount. A part of the Pleasant Valley decree (2,500 acre-feet) was also

transferred to Yamcolo Reservoir (see previous discussion). In 1994, UYWCD made 20,854 acre-feet of this conditional water right absolute at Stagecoach Reservoir.

The third water right is associated with the former Four Counties Ditches No. 1 and No. 3, a conditional direct flow right owned by the UYWCD that has been changed to allow storage in Stagecoach Reservoir. In the Water Court change case, storage at Stagecoach Reservoir pursuant to these rights is limited to the amounts of water physically available in priority at the original headgate locations, which are located on several of the major tributaries that flow into the Yampa from the drainage area north of Rabbit Ears Pass. From prior studies performed by W. W. Wheeler, it has been determined that the yield of the Four Counties water rights is generally limited to the seasonal runoff period, April through mid-July. After mid-July, low streamflows and local calls on the tributaries preclude diversions by the Four Counties rights.

In 1994, UYWCD made a portion of the Four Counties direct flow rights absolute for storage in Stagecoach Reservoir in the cumulative amount of 83 cfs (10 cfs at a decreed headgate location on a branch of Granite Creek; 11 cfs at a location on Granite Creek; 26 cfs at a location on Fishhook Creek; and 36 cfs at a location on Long Park Creek). An average annual volumetric limit has been developed to represent the available yield of the Four Counties water rights at the four original headgate locations for which flow rates have been made absolute. These average yield estimates (acre-feet) are shown below. Note that these values do not represent the potential yield of the entire Four Counties Project water rights owned by the UYWCD but rather represent an estimate of the potential yield which could reasonably be expected to be used for storage at Stagecoach Reservoir.

Potential Yield of Absolute Four Counties Water Rights (acre-feet)

April	**May**	**June**	**July**	**TOTAL**
465	3,679	7,639	1,196	12,979

When Stagecoach Reservoir is being filled, storage under the senior Four Counties direct flow rights should be limited to no more than the available yield as recommended by the above values.

The UYWCD originally allocated a total of 15,000 acre-feet of storage water in Stagecoach Reservoir for sale annually as follows: Municipal Users – 2,000 acre-feet; Industrial Users (Tri-State) – 9,000 acre-feet; and Agricultural Users – 4,000 acre-feet. Pursuant to two 1992 Agreements between the UYWCD and Tri-State, the parties agreed to exchange the 4,000 acre-feet of water that Tri-State is entitled to in Yamcolo Reservoir to a Tri-State account in Stagecoach and similarly exchange the 4,000 acre-feet of Agricultural water in Stagecoach upstream to storage in Yamcolo Reservoir. Pursuant to these agreements, Tri-State also reduced its original industrial allocation from 9,000 acre-feet to 7,000 acre-feet. As a result of these Agreements, the storage in Stagecoach Reservoir is now allocated as follows:

General Allocation	Amount of Reservoir Storage (acre-feet)
Industrial Water (Tri-State)	11,000 acre-feet
Municipal Water	2,000 acre-feet
Unallocated M&I Water	2,000 acre-feet
Recreation and Dead Storage	18,275 acre-feet
TOTAL	33,275 acre-feet

The municipal water in Stagecoach is currently under contract to the following municipal water providers.

Name of Municipality	Amount of Reservoir Storage (acre-feet)
Steamboat Springs	552 acre-feet
Morrison Creek WSD	500 acre-feet
Mt. Werner WSD	200 acre-feet
Town of Hayden	200 acre-feet
Peabody Coal	100 acre-feet
Tree House Metro Dist.	50 acre-feet
Dakota Ridge	50 acre-feet
Raindrops Excavating	50 acre-feet

The UYWCD installed a hydroelectric generation facility on the outlet works of Stagecoach Dam and produces electrical energy from the flows that pass through the reservoir, either as bypassed inflows or as reservoir releases. In gaining environmental approvals for the construction of Stagecoach, the UYWCD committed to maintaining downstream flow of 40 cfs or the reservoir inflow, whichever is less, from December 1 through July 31; and a minimum release of 20 cfs from August 1 through November 30.

According to the UYWCD, the hydro equipment is not sized to feasibly operate at flow rates less than 40 cfs. Therefore, it has been the practice of the UYWCD to operate at a minimum flow rate of 40 cfs. The maximum flow rate that can be accommodated by the turbines is approximately 115 cfs. Bypassed inflows and/or releases in excess of 115 cfs are routed through the larger outlet of the dam, bypassing the hydro plant.

2.11. Allen Basin Reservoir

Allen Basin Reservoir (WDID 583500) is a small irrigation reservoir located near the headwaters of Middle Hunt Creek. It plays a significant role in the irrigation water supply in this water limited area of the Yampa River basin. The reservoir has a decreed capacity of 2,250 acre-feet which is also reported to be its active capacity, there being no dead storage. The storage right was adjudicated in 03-30-1964 and carries an appropriation date of 10-20-1953. The Division 6 engineer provided a regression equation relating the reservoir water surface area to the capacity. This equation is recommended for purposes of estimating evaporation losses from the reservoir:

Surface Area = 8.53*(Capacity)^0.31

The reservoir stores water from Middle Hunt Creek and also stores water imported from tributaries of South Hunt Creek, via the Allen Basin Supply Ditch (WDID 580506). This supply canal, although large in decreed capacity at 60 cfs, diverts relatively small quantities of water during the spring runoff, prior to the more senior rights on the streams calling for water.

Storage water in Allen Basin Reservoir is used to provide supplemental irrigation supplies to several direct flow ditch structures in the Hunt Creek drainage. Using information provided by the water commissioner, those users and ditch structures were identified as follows:

Ditch Structure	Structure ID	Storage Allocation (acre-feet)
Bull Creek Ditch	580566	179
Collins Ditch	580591	593
Lateral A Ditch	580730	333
Mill Creek Ditch 5	81085	582
Simon Ditch	580863	287
Misc. small structures	N/A	276
TOTAL		2,250

2.12. Lake Catamount

Lake Catamount Reservoir (WDID 583631) is located on the main stem of the Yampa River, between Stagecoach Dam and Steamboat Springs. The reservoir is used primarily for recreational uses for the planned residential and ski development near the lake. Elevation-area-capacity data was obtained from the original design plans and verified with the division engineer. From this information, it was determined that the maximum (and active) storage capacity of the reservoir is about 7,422 acre-feet. The division engineer also provided a regression equation relating the reservoir surface area to the storage capacity:

Surface Area = 2.47*(Capacity)^0.60

According to the State's tabulation of water rights, Lake Catamount holds the following storage water rights:

WDID	Adjudication Date	Appropriation Date	Administration No.	Amount (acre-feet)
583631	12-31-1972	07-20-1972	44761.00000	7,800
	12-31-1991	09-01-1978	51134.46995	4,000

Note that the first storage right is in excess of the actual reported capacity of the reservoir. The second right is decreed as a refill right.

According to the Division 6 Engineer and Water Commissioner, the reservoir is normally operated to keep it full. Historically there has been a practice to lower the reservoir by releasing about 2,000 acre feet in October to provide a measure of protection against the formation of frazil ice near the reservoir inlet during the winter months. It is our understanding that this practice is being discontinued.

2.13. Fish Creek Reservoir

The existing Fish Creek Reservoir (WDID 583508) is owned by the city of Steamboat Springs and used as reserve raw water storage for the city and for the Mt. Werner Water & Sanitation District. The present capacity, all of which is active, is approximately 4,042 acre-feet. Elevation-area-capacity data was obtained from the dam design drawings and verified with the division engineer and city personnel. The division engineer also provided a regression equation relating the reservoir water surface area to the storage capacity:

Surface Area = 2.41*(Capacity)^0.49

The reservoir was enlarged in 1995 and 1996, increasing total storage from its former capacity of 1,842 acre-feet. It is our understanding that the enlargement is intended to provide additional raw water storage for both the city and the Mt. Werner Water & Sanitation District.

Fish Creek Reservoir has the following storage water rights:

WDID	Adjudication Date	Appropriation Date	Administration No.	Amount (acre-feet)
583509	09-14-1946	02-15-1942	33782.33648	1,175.43
	03-30-1964	08-17-1960	40406.00000	666.63

Steamboat Springs has also obtained conditional water storage rights in the amount of 2,200 acre-feet, to be implemented when the enlargement is complete.

According to city personnel, the reservoir is typically filled during the months of April and May. Yield studies performed by the city indicated the reservoir can fill in nearly every year, including dry runoff years. Releases from the reservoir are typically made beginning in early August when the natural streamflow in Fish Creek begin to decrease and are inadequate for the municipal demands. The reservoir water is then used to supplement the direct flow diversions during the remainder of the late summer, fall and winter months. Because the reservoir is currently inaccessible during the winter months, the reservoir outlet valve is set at a pre-determined flow rate to provide for the ensuing winter demands. This release may be slightly greater than the actual demand. Historically, the annual reservoir release has averaged approximately 1,000 acre-feet.

2.14. Steamboat Lake

Steamboat Lake (WDID 583787) is located on Willow Creek, a tributary of the Elk River. The reservoir is owned and operated by the Colorado Division of Parks and Outdoor Recreation (CPOR) and is used primarily for recreational and industrial purposes. According to the design plans for the reservoir and the elevation-capacity table, the capacity at the normal spillway elevation is approximately 23,064 acre-feet, which represents the active capacity of the reservoir, there being no dead storage below the elevation of the outlet works. Historically, CPOR has been allowed to store water above the normal spillway elevation, encroaching upon the flood surcharge capacity of the reservoir. This arrangement has been made permanent with the installation of gates in the spillway to allow this storage and by obtaining an additional water right to store in the additional capacity (approximately 3,300 acre-feet). The Division 6 engineer provided a regression equation relating the reservoir water surface area to the storage capacity

Surface Area = 0.41*(Capacity)^0.78

Steamboat Lake presently has the following storage water rights:

WDID	Adjudication Date	Appropriation Date	Administration Date	Amount (acre-feet)
583787	05-30-1972	10-18-1961	41727.40833	5,000
	05-30-1972	10-18-1961	41727.40833	18,064
	12-31-1990	05-15-1968	51134.43234	3,300
TOTAL				26,364

Although they carry the same priority, the original water right for 5,000 acre-feet is decreed primarily for industrial uses whereas the right for 18,064 acre-feet is decreed for recreational and piscatorial uses. The junior decree is for the storage in the flood surcharge capacity as described above.

Prior to the initial construction of the Steamboat Lake dam, CPOR entered into an agreement with the Salt River Generating Co. and Colorado-Ute Electric Association (the partners in the operation of the Hayden Station power plant) which provided for partial payment of the construction costs by the latter and for the acquisition of a perpetual right to withdraw from the reservoir up to 5,000 acre-feet of water per year. This water is the reserve back-up water supply for the operation of the Hayden Station. (In 1992, Public Service Co. and PacifiCorp acquired Colorado-Ute's interests in the contract).

Of the 3,300 acre-foot storage right in the surcharge storage pool, CPOR has contracted to lease up to 125 acre-feet per year to the Cyprus Empire Corp. for use in an augmentation plan. The use of the water for this purpose had been previously approved by the Water Court.

In 1997, as an element of the Yampa Recovery Plan, CWCB and CPOR jointly obtained a decree to change the use of 3,150 af of Steamboat Lake water to instream flow use to preserve the natural environment. Furthermore, the U.S. Fish and Wildlife Service

(USFWS), CWCB, and CPOR entered into a lease-sublease agreement whereby USFWS leases 2,000 af/yr for maintenance of instream flows, with option to lease additional water, depending on availability as determined by CPOR. According to the lease, USFWS determines the need for the water based on observations of the Maybell gage, but the lease does not quantify a minimum flow level that would trigger the release. The rate of release is not to exceed 200 cfs. The lease year runs from October through September, and generally, the 2,000 af has been released through late August and September. The lease was signed in 1996 and provided for annual renewal at the option of USFWS for four additional years.

2.15. Elkhead Creek Reservoir

Elkhead Creek Reservoir (WDID 443902) is located on Elkhead Creek, a tributary of the Yampa River just upstream of the city of Craig. The reservoir was originally constructed by the CDOW and the Yampa Project Participants (the operating consortium for the Craig Station power plant) and was intended for recreational and industrial purposes. The Yampa Participants funded a portion of the construction in return for full use of the active storage capacity in the reservoir above Elevation 6340.5, which was estimated to be approximately 8,310 acre-feet. CDOW retained the use of the storage capacity below this elevation, including the dead storage below the outlet works.

In 1990, the city of Craig acquired all of the CDOW's interests in the reservoir, subject to a contractual commitment to not encroach upon the dead storage below the elevation of the outlet work invert, which capacity is reserved as a conservation pool for the benefit of the CDOW. In 1991, the reservoir was emptied to the approximate dead storage level to perform maintenance on the outlet works and at the same time, re-survey the capacity of the reservoir. From this new survey data, the city has estimated that the active capacity above the outlet works invert is about 10,422 acre-feet. Of this storage, the Yampa Participants' entitlement is estimated to be about 8,754 acre-feet and the city's entitlement about 1,668 acre-feet. Assuming that the original capacity of the total reservoir, as decreed, is 13,699 acre-feet, this would result in a dead storage capacity of about 3,277 acre-feet. These assumptions were all confirmed through conversations with city of Craig personnel.

The Division 6 engineer provided a regression equation relating the reservoir water surface area to the storage capacity:

Surface Area = 3.33*(Capacity)^0.526

The following water rights are associated with Elkhead Creek Reservoir:

WDID	Adjudication Date	Appropriation Date	Administration No.	Amount (acre-feet)
443902	05-30-1972	10-01-1966	42642.00000	5,389
	12-31-1973	06-20-1972	44925.44731	8,310
TOTAL				13,699

The first priority represents CDOW's original storage right for recreational and fishery purposes; the second right is the Yampa Participants' right for industrial storage. Based on the new capacity survey and the 1990 agreements, the allocated storage is now 8,754 acre-feet for industrial uses by the Yampa Participants, 1,668 acre-feet for municipal uses by the city and an estimated 3,277 acre-feet for conservation purposes in the dead storage capacity.

The industrial water is available to satisfy shortages which may occur at the Craig Station Units 1 and 2 after exercise of the senior direct flow rights diverted through the Craig Station Ditch and Pipeline (WDID 440522). Refer to the documentation describing the Craig Station operations for additional information.

The city's storage water is available to satisfy shortages that may occur after utilization of the city's direct flow water rights on the Yampa River, specifically the Craig Water Supply Pipeline (WDID 440581).

2.16. Lester Creek Reservoir (Pearl Lake)

Lester Creek Reservoir (WDID 583521) is located on Lester Creek, a tributary of the Elk River downstream of Steamboat Lake. The reservoir is owned and operated by CDOW and used exclusively for recreational and fishery purposes.

According to elevation-capacity-area data provided by the Division 6 engineer, the total capacity of the reservoir is estimated to be approximately 5,657 acre-feet, which corresponds to the amount described in the water storage right. The storage right was decreed on March 30, 1964 and was granted an appropriation date of May 5, 1959 (Administration No. 39936.00000). All of the capacity is considered active, there being no dead storage below the outlet works. The division engineer has also provided a regression equation relating the reservoir water surface area to the storage capacity:

Surface Area = 1.12*(Capacity)^0.58

3. Yampa River Structure Information and Basin Meeting Notes

This section contains information that was gathered during the initial CDSS development phase, regarding specific, individual diversion structures. The objective at the time was to identify which structures should be included explicitly in the water resources planning model of the Yampa River. The information is historical, reflecting the thinking at the time and conditions at the time. It is valuable, however, for its detail on specific structures from those who have observed the diversion systems and have first-hand familiarity with their operations.

3.1. Annotated Structure Listing

The number of diversion structures explicitly included in the CDSS water resources planning model for each basin was based on the State's recommendation to simulate 75 percent of the decreed water rights. In the Yampa basin, by accumulating net absolute rights for each structure and ranking the structures, it was determined that structures with rights amounting to 5.0 cfs or more comprised 75 percent of the basin's rights. The table in this section lists structures that meet that criterion for inclusion. The list was then annotated, however, to document input from Division 6 personnel based on observations of actual practices. These observations may be generally useful to CDSS users who are trying to enhance their understanding of water use in the Yampa River basin.

Table 3.1

Yampa Basin Diversion Structures with Water Rights ≥ 5 cfs

WDID	Structure Name	Decree Amount (cfs)	Cumulative % of Total	Is Structure in Final Model?	Comments
440694	MAYBELL CANAL	129	0.0203	Yes	
581583	STAGECOACH HYDROELECTRIC	110	0.03761	Yes	
440522	CRAIG STATION D & PL	90.63	0.05188	Yes	
570539	GIBRALTAR DITCH	80	0.06447	Yes	
440675	JUNIPER MTN TUNNEL	67.67	0.07512	Yes	
580920	WALTON CREEK DITCH	67	0.08566	Yes	
440692	MARTIN CK DITCH	62	0.09542	Yes	
440589	DEEP CUT IRR D	60.45	0.10494	Yes	
580506	ALLEN BASIN SUPPLY D	60	0.11438	Yes	
570592	SHELTON DITCH	53.52	0.1228	Yes	
580530	BAXTER DITCH	49.6	0.13061	Yes	
440586	D D & E DITCH	49.33	0.13837	Yes	
570611	WALKER IRRIG DITCH	43.5	0.14522	Yes	

Table 3.1

Yampa Basin Diversion Structures with Water Rights ≥ 5 cfs

WDID	Structure Name	Decree Amount (cfs)	Cumulative % of Total	Is Structure in Final Model?	Comments
584684	SARVIS DITCH	43	0.15199	Yes	Transbasin diversion into Red Dirt Creek
580897	SUTTLE DITCH	42.97	0.15875	Yes	
440558	BRANNAN FEEDER D	42.4	0.16542	No	Removed at basin meetings, minimal use
580539	BIG MESA DITCH	42.33	0.17208	Yes	
580944	WOOLERY DITCH	37.4	0.17797	Yes	
580642	FISH CR MUN WATER INTAKE	36.977	0.18379	Yes	
440687	LILY PARK PUMP NO 1	36.67	0.18956	Yes	
440511	WISCONSIN DITCH	32	0.1946	Yes	
580714	KELLER DITCH	31.39	0.19954	Yes	
580763	MANDALL DITCH	31.14	0.20444	Yes	
580622	EGERIA DITCH	31.02	0.20932	Yes	
584685	STILLWATER DITCH	30.83	0.21417	Yes	Add to network line diagram below Yamcolo Reservoir
570512	COLO UTILITIES D & PL	30	0.21889	Yes	
440724	NORVELL DITCH	30	0.22362	Yes	
580589	COAL CREEK DITCH	28	0.22802	Yes	Transbasin diversion into Moody Creek
580627	ENTERPRISE DITCH	28	0.23243	Yes	
440779	SYNTHETIC PRODUCTS DITCH	26.84	0.23665	No	Removed per Division 6 recommendation
570510	CARY DITCH CO DITCH	25.99	0.24074	Yes	
580694	HOOVER JACQUES DITCH	25.92	0.24482	Yes	
440700	MCKINLAY DITCH NO 2	25.66	0.24886	Yes	
441122	VAUGHN PUMP	25	0.2528	Yes	
540583	TROWEL DITCH	24.72	0.25669	Yes	
440581	CRAIG WATER SUPPLY PL	24.54	0.26055	Yes	
540519	DUNCAN DITCH NO 1	24.5	0.2644	No	Not on modeled tributary
580868	SODA CREEK DITCH	23.927	0.26817	Yes	
580649	FRANZ DITCH	23.8	0.27192	Yes	
580783	MORIN DITCH	23.66	0.27564	Yes	
440657	HUSTON DITCH	23.49	0.27934	Yes	
440763	SMITH DITCH	22.99	0.28295	Yes	
440607	EGRY MESA DITCH	22.91	0.28656	Yes	
440524	AQ DITCH 1	22.86	0.29016	Yes	
580564	BUCKINGHAM MANDALL D	22.73	0.29374	Yes	
440688	LITTLE BEAR DITCH	22.5	0.29728	Yes	
580879	STAFFORD DITCH	22.04	0.30075	Yes	
570508	BROCK DITCH	21.5	0.30413	Yes	
580626	ELK VALLEY DITCH CO. D.	21.24	0.30747	Yes	
440573	CATARACT DITCH	20.8	0.31075	Yes	
440518	YELLOW JACKET DITCH NO	20.65	0.314	Yes	

Table 3.1

Yampa Basin Diversion Structures with Water Rights ≥ 5 cfs

WDID	Structure Name	Decree Amount (cfs)	Cumulative % of Total	Is Structure in Final Model?	Comments
	1				
440706	MILK CK DITCH	20	0.31714	Yes	
440538	AVERILL DITCH	19.9	0.32028	Yes	
580568	BURNETT DITCH	19.7	0.32338	Yes	
540531	HEELEY DITCH	19.58	0.32646	Yes	
440590	DEER CK & MORAPOS D	19.5	0.32953	Yes	
570622	WILLIAMS IRRIG DITCH	19.43	0.33258	Yes	
574629	RICH DITCH	19.33	0.33563	Yes	Transbasin diversion into Oak Creek
570555	LAST CHANCE DITCH	19.29	0.33866	Yes	
440611	ELK TRAIL DITCH	19	0.34165	Yes	
440707	MILK CK DITCH 1	19	0.34464	Yes	
580662	GRAHAM & BENNETT D	18.99	0.34763	Yes	
440702	MCINTYRE DITCH	18.7	0.35057	Yes	
550506	MAJORS PUMP NO 2	18.64	0.35351	Yes	
440587	D D FERGUSON D NO 2	18.33	0.35639	Yes	
580639	FINGER ROCK PL NO 2	18.24	0.35926	No	Removed, small diversion feeding fish hatchery
580643	FIX DITCH	18.04	0.3621	Yes	
570563	MARSHALL ROBERTS DITCH	17.94	0.36493	Yes	
440584	CROSS MTN PUMP NO 1 & 2	17.78	0.36772	Yes	
580618	DUQUETTE DITCH	17.66	0.3705	Yes	
440785	TIPTON IRR DITCH	17.16	0.3732	Yes	
440517	YAMPA VAL STOCK BR CO D	16.7	0.37583	Yes	
580808	OAKTON DITCH	16.58	0.37844	Yes	
540591	WILLOW CK DITCH	16.17	0.38099	Yes	
440748	ROBY DITCH NO 2	16.06	0.38352	Yes	
440583	CROSS MTN PUMP - GROUNDS	16	0.38603	Yes	
440812	HART DITCH	16	0.38855	Yes	
440726	OWEN CARRIGAN DITCH	16	0.39107	Yes	
570545	HOMESTEAD DITCH	15.92	0.39357	Yes	
580752	LUCAS SEEP WASTE D 2	15.833	0.39607	No	Removed, minimal use
570544	HIGHLAND DITCH	15.66	0.39853	Yes	
570513	CONNELL DITCH	15.66	0.401	Yes	
440509	WILSON DITCH	15.61	0.40345	Yes	
440541	BAILEY DITCH	15.58	0.4059	Yes	
550509	ONECO PUMP NO 2	15.34	0.40832	Yes	
440729	PATRICK SWEENEY D	15.1	0.4107	Yes	
580570	BURNT MESA SUPPLY D	15	0.41306	No	Removed, small reservoir feeder
440638	HADDEN BASE DITCH	15	0.41542	Yes	
582102	RAMS HORN FEEDER D	15	0.41778	No	Removed per Division 6 recommendation
580634	FERGUSON DITCH	15	0.42014	Yes	

Table 3.1

Yampa Basin Diversion Structures with Water Rights ≥ 5 cfs

WDID	Structure Name	Decree Amount (cfs)	Cumulative % of Total	Is Structure in Final Model?	Comments
570612	WEST SIDE DITCH	15	0.4225	No	Removed, minimal use
580777	MILL DITCH 1	14.79	0.42483	Yes	
580943	WOODCHUCK D SODA CK HG	14.79	0.42715	Yes	
570623	WILLIAMS PARK DITCH	14.7	0.42947	Yes	
580916	UPPER PLEASANT VALLEY D	14.66	0.43178	Yes	
570519	DENNIS & BLEWITT D	14.66	0.43408	Yes	
580623	EKHART DITCH	14.57	0.43638	Yes	
580569	BURNT MESA D	14.49	0.43866	Yes	
580633	FELIX BORGHI DITCH	14.32	0.44091	Yes	
440651	HIGHLAND DITCH	14.2	0.44315	Yes	
540554	PERKINS FOX DITCH	14	0.44535	Yes	
540538	JOLLEY DITCH	14	0.44755	No	Not on modeled tributary
440786	TISDEL D NO 2	13.998	0.44975	Yes	
580915	UPPER ELK RIVER D CO. D	13.79	0.45193	Yes	
570533	EMRICH FEEDER DITCH	13.74	0.45409	No	Removed per Division 6 recommendation
440525	AQ DITCH 2	13.7	0.45624	No	Removed at basin meetings, use at 524
580746	LOOK WASTE WATER D 1	13.6	0.45838	No	Removed, minimal use
440652	HIGHLAND AKA HIGHLINE D	13.55	0.46052	Yes	
440612	ELKHORN IRR DITCH	13.3	0.46261	Yes	
580577	CAMPBELL DITCH	13.3	0.4647	Yes	
570635	KOLL DITCH	13.22	0.46678	Yes	
570529	ECKMAN PARK D SYS (1-5)	13.13	0.46885	No	Removed, no data
540532	HOME SUPPLY DITCH	13.1	0.47091	Yes	
580895	SUNNYSIDE DITCH 1	13	0.47296	Yes	
580743	LOOK SEEPAGE D 1	12.9	0.47499	No	Removed, minimal use
580549	BORLAND VAIL DITCH	12.83	0.47701	Yes	
580935	WHITELEY NELSON D SYS	12.74	0.47901	No	Removed, averages 2.8 cfs
570608	TROUT CREEK DITCH 3	12.66	0.481	Yes	
570561	MALE MOORE CO DITCH	12.62	0.48299	Yes	
550507	NINE MILE IRR DITCH	12.6	0.48497	Yes	
550513	VISINTAINER DITCH	12.6	0.48696	Yes	
580628	EXCELSIOR DITCH	12.5	0.48892	Yes	
440698	MCDONALD DITCH	12.45	0.49088	Yes	
570579	R E CLARK DITCH	12.43	0.49284	Yes	
580500	ACTON D	12.32	0.49478	Yes	
580687	HIGHLINE BEAVER DITCH	12.16	0.49669	Yes	
540555	PERKINS IRR DITCH	12.08	0.49859	Yes	
580863	SIMON DITCH	12	0.50048	Yes	
440830	OLD SWEENEY DITCH	12	0.50237	Yes	
550519	RINKER PUMP D	12	0.50426	Yes	
540570	SLATER PARK DITCH NO 1	12	0.50615	Yes	

Table 3.1

Yampa Basin Diversion Structures with Water Rights ≥ 5 cfs

WDID	Structure Name	Decree Amount (cfs)	Cumulative % of Total	Is Structure in Final Model?	Comments
540590	WEST SIDE CANAL	11.92	0.50802	No	Included in Wyoming Irrigation
440735	PINE CK DITCH	11.9	0.5099	Yes	
580940	WITHER DITCH	11.88	0.51177	No	Removed, averages 1.0 cfs
580730	LATERAL A DITCH	11.84	0.51363	Yes	
580695	HOT SPGS CR HIGHLINE D	11.83	0.51549	Yes	
440570	CARD DITCH	11.79	0.51735	Yes	
580889	STUCKEY SODA CR D	11.75	0.5192	No	Removed, minimal use
580945	WOOLEY DITCH	11.66	0.52103	Yes	
580541	BIRD DITCH	11.55	0.52285	Yes	
440593	DENNISON & MARTIN D	11.33	0.52463	Yes	
540574	SLATER PARK DITCH NO 5	11.3	0.52641	Yes	
440863	HENRY SWEENEY DITCH	11.1	0.52816	Yes	
440580	CRAIG IRR DITCH	11.09	0.5299	No	Removed at basin meetings, transfer from
580665	GUIDO DITCH	11	0.53164	Yes	
580749	LOWER PLEASANT VALLEY D	11	0.53337	Yes	
540517	DECKER DITCH NO 1	11	0.5351	No	Not on modeled tributary
570584	SADDLE MOUNTAIN DITCH	11	0.53683	Yes	
580805	OAK CREEK DITCH	11	0.53856	Yes	
440650	HIGHLINE MESA BAKER D	10.97	0.54029	Yes	
540543	LUCHINGER DITCH	10.8	0.54199	Yes	
570525	EAST SIDE DITCH 2	10.65	0.54366	Yes	
440740	RATCLIFF DITCH	10.64	0.54534	Yes	
580821	PENNSYLVANIA DITCH	10.6	0.54701	Yes	
580738	LINDSEY DITCH	10.33	0.54863	Yes	
440677	K DIAMOND DITCH	10.18	0.55023	Yes	
540582	TIMBERLAKE DITCH	10	0.55181	No	Removed, no data
550515	GORDON C. WINN PUMP 2	10	0.55338	No	Removed, averages 1.5 cfs including 514
440820	LOWRY SEELEY PUMP	10	0.55495	Yes	
551011	DEWEY SHERIDAN D	10	0.55653	No	Removed, no data
550537	LEFEVRE NO 1 PUMP	10	0.5581	Yes	
581085	MILL CREEK DITCH	10	0.55968	Yes	
581021	LEE IRRIGATION D	10	0.56125	Yes	
440575	CLAPP IRR DITCH	9.99	0.56282	No	Removed at basin meetings, minimal use
440731	PECK IRRIG D	9.84	0.56437	Yes	
570524	EAST SIDE DITCH	9.5	0.56587	Yes	
440711	MOCK DITCH	9.5	0.56736	Yes	
580591	COLLINS DITCH	9.32	0.56883	Yes	
580884	STEAMBOAT GARDENS D	9.25	0.57028	No	Removed, not used in 15 years

Table 3.1

Yampa Basin Diversion Structures with Water Rights ≥ 5 cfs

WDID	Structure Name	Decree Amount (cfs)	Cumulative % of Total	Is Structure in Final Model?	Comments
440814	HIGHLINE DITCH	9.24	0.57174	Yes	
580801	NORTH HUNT CREEK DITCH	9.19	0.57318	Yes	
580914	UNION DITCH	9	0.5746	Yes	
440998	DRY COTTONWOOD DITCH	9	0.57602	Yes	
540520	DUNCAN DITCH NO 2	9	0.57743	No	Not on modeled tributary
540530	HAY QUEEN DITCH	9	0.57885	No	Not on modeled tributary
440828	MOCK DITCH NO 3	8.696	0.58022	Yes	
540513	CLARK BUTLER WESTFALL D	8.67	0.58158	No	Possibly irrigates in Wyoming
580847	SAND CREEK DITCH	8.62	0.58294	Yes	
440750	ROUND BOTTOM D NO 2	8.6	0.58429	Yes	
580612	DEVER D	8.5	0.58563	Yes	
580684	HERNAGE & KOLBE DITCH	8.5	0.58697	Yes	
440644	HARPER DITCH 1	8.42	0.58829	Yes	
580638	FINGER ROCK PL NO 1	8.394	0.58962	No	Removed, small diversion feeding fish hatchery
440699	MCKINLAY DITCH NO 1	8.33	0.59093	Yes	
440572	CARRIGAN-AVERILL D	8.32	0.59224	Yes	
580798	NICKELL DITCH	8.27	0.59354	Yes	
580756	LYON DITCH 2	8.2	0.59483	Yes	
580826	PONY CREEK D	8.1	0.5961	Yes	
440790	UTLEY DITCH	8.1	0.59738	Yes	
580933	WHIPPLE DITCH	8.08	0.59865	Yes	
580532	BEAVER CREEK D	8.08	0.59992	Yes	
440660	J A MARTIN DITCH	8.05	0.60119	Yes	
580807	OAK DALE DITCH	8.03	0.60245	Yes	
550504	ESCALANTA PUMP 2	8.01	0.60371	Yes	
550503	ESCALANTA PUMP 1	8.01	0.60497	No	Include under 504
542075	WILLOW CK SEEP & WASTE D	8	0.60623	No	Not on modeled tributary
580799	N SO SIDE DIS D	8	0.60749	No	Removed, minimal use
582374	STEAMBOAT SKI SNOW PL	8	0.60875	Yes	
580892	STUCKEY SODA CR FKS D	8	0.61001	No	Removed per Division 6 recommendation
580866	SNOW BANK DITCH	8	0.61127	Yes	
440806	ELLGEN NO 2 DITCH	8	0.61253	Yes	
580599	CULLEN DITCH 2	8	0.61379	Yes	
440645	HARPER DITCH 2	7.93	0.61503	Yes	
440647	HAUGHEY IRR DITCH	7.9	0.61628	Yes	
440526	AQ DITCH 3	7.8	0.61751	No	Removed at basin meetings, use at 524
440628	GIBBONS WILSON JORDAN D	7.8	0.61873	Yes	

Table 3.1

Yampa Basin Diversion Structures with Water Rights ≥ 5 cfs

WDID	Structure Name	Decree Amount (cfs)	Cumulative % of Total	Is Structure in Final Model?	Comments
440833	RICHARDSON DITCH	7.8	0.61996	No	Inactive since 1980
580663	GREER DITCH	7.8	0.62119	Yes	
440772	STUCKEY DITCH	7.75	0.62241	No	Removed per Division 6 recommendation
570609	TROUT CREEK DITCH 2	7.66	0.62361	Yes	
580753	LUCAS SEEP WASTE D 1	7.66	0.62482	No	Removed, minimal use
440614	ELLIS & KITCHENS D	7.66	0.62602	Yes	
440613	ELLGEN DITCH	7.6	0.62722	Yes	
580717	KINNEY DITCH	7.6	0.62842	Yes	
580653	FRYE SYST D 1	7.5	0.6296	No	Removed, minimal use
440821	MACK DITCH	7.5	0.63078	Yes	
540500	ANDERSON DITCH	7.5	0.63196	No	Removed, averages 2.2 cfs
540548	MORGAN & BEELER D	7.48	0.63314	Yes	
580588	CLARK & BURKE DITCH	7.4	0.6343	Yes	
540515	DAVIDSON DITCH	7.33	0.63545	No	Not on modeled tributary
580508	ALPHA DITCH	7.2	0.63659	Yes	
540561	RIVAST & ALLEN D	7.16	0.63771	No	Removed, not active
440747	ROBY D AKA ROBY D NO 1	7.143	0.63884	Yes	
580731	LAUGHLIN DITCH	7.14	0.63996	Yes	
440801	CROSS MTN PUMP - GUESS	7.14	0.64109	Yes	
580848	SANDELIN DITCH	7	0.64219	No	Removed, minimal use
440851	MORGAN DITCH	7	0.64329	Yes	
542068	STATE LINE WW DITCH	7	0.64439	No	Little data, diverts 2 cfs
570585	SAGE CREEK DITCH	7	0.64549	No	Removed, minimal use
581091	WOODCHUCK D GUNN CK HG	7	0.64659	Yes	
571034	SPENCER DIVERSION	7	0.6477	No	Removed, minimal use
580685	HIGH MESA IRR D	7	0.6488	Yes	
552035	HELLS CANYON DITCH	7	0.6499	No	Not on modeled tributary
540505	BAXTER DITCH	7	0.651	No	Not on modeled tributary
540516	DAVIDSON DUTTON D	7	0.6521	No	Not on modeled tributary
540594	WOODBURY DITCH	6.98	0.6532	Yes	
440765	SOUTH SIDE DITCH	6.92	0.65429	Yes	
440519	YELLOW JACKET DITCH NO 2	6.88	0.65537	Yes	
580722	LAFON DITCH	6.83	0.65645	Yes	
541070	ANDERSON D GRIEVE HEADGT	6.83	0.65752	No	Not on modeled tributary
440674	JUNIPER DITCH	6.83	0.6586	No	Inactive since 1981, averages 1 cfs
440776	SULLIVAN SEEPAGE D	6.81	0.65967	No	Removed at basin

Table 3.1

Yampa Basin Diversion Structures with Water Rights ≥ 5 cfs

WDID	Structure Name	Decree Amount (cfs)	Cumulative % of Total	Is Structure in Final Model?	Comments
					meetings, small diversion
440749	ROUND BOTTOM D NO 1	6.8	0.66074	Yes	
540653	GEORGIOU DITCH	6.8	0.66181	No	Not on modeled tributary
440723	NICHOLS DITCH NO 1	6.73	0.66287	Yes	
580813	PALISADE DITCH	6.7	0.66392	Yes	
552034	HAYSTACK PUMP	6.7	0.66498	No	Not on modeled tributary
580559	BROOKS DITCH	6.7	0.66603	Yes	
440778	SUNBEAM DITCH	6.7	0.66709	Yes	
580791	MUDDY DITCH 1	6.7	0.66814	Yes	
440579	COLLOM DITCH NO 2	6.66	0.66919	No	Removed at basin meetings, minimal use
440770	STARR IRRIG DITCH	6.6	0.67023	Yes	
540572	SLATER PARK DITCH NO 3	6.6	0.67127	Yes	
440661	J P MORIN DITCH	6.6	0.67231	Yes	
580917	VAIL SAVAGE DITCH	6.57	0.67334	Yes	
540507	BEELER DITCH	6.5	0.67436	Yes	
550508	NINE MILE IRR PL	6.5	0.67539	Yes	
580590	COLEMAN DITCH	6.5	0.67641	Yes	
580908	TRULL MORIN DITCH	6.5	0.67743	Yes	
440516	YAMPA DITCH	6.5	0.67845	No	Removed at basin meetings, minimal use
570549	J O K DITCH	6.5	0.67948	No	Removed, minimal use
580849	SANDELIN STORAGE POWER D	6.5	0.6805	No	Removed, minimal use, non-consumptive
442207	BROCK D VANTASSEL TRANS	6.33	0.6815	No	Removed at basin meetings, minimal use
580721	L L WILSON D	6.32	0.68249	Yes	
440751	ROUND BOTTOM DITCH	6.3	0.68348	Yes	
580715	KERN FEEDER D	6.3	0.68447	No	Removed, feeds a small pond
440501	W R DEAKINS DITCH	6.25	0.68546	No	Removed, averages less than 5 cfs
540564	SALISBURY DITCH	6.2	0.68643	Yes	
580774	METCALF DITCH 2	6.17	0.68741	No	Removed, minimal use
440601	DUNSTON DITCH	6.13	0.68837	Yes	
440514	WOOLEY & JOHNSON D	6.04	0.68932	Yes	
570576	ORNO DITCH	6.01	0.69027	Yes	
570506	BOETTLER DITCH	6	0.69121	No	Not on modeled tributary
580955	YELLOW JACKET DITCH	6	0.69215	No	Removed, averages 4.0 cfs
580716	KERNAGHAN D CO D	6	0.6931	No	Removed, minimal use
550538	DUNN PUMP & PL	6	0.69404	No	Remove, no data since

Table 3.1

Yampa Basin Diversion Structures with Water Rights ≥ 5 cfs

WDID	Structure Name	Decree Amount (cfs)	Cumulative % of Total	Is Structure in Final Model?	Comments
					1982, averaged 4 cfs
580625	ELGIN CREEK DITCH	6	0.69499	No	Removed, minimal use
440527	AIR LINE IRR D	6	0.69593	Yes	
540568	SLATER FORK DITCH	6	0.69688	Yes	
580582	CHARLES & A LEIGHTON D	6	0.69782	Yes	
580604	DAY DITCH	6	0.69876	Yes	
580542	BISHOP RATCLIFF D 1	6	0.69971	No	Removed, minimal use
440691	M DITCH	6	0.70065	Yes	
570515	CORLISS DITCH	6	0.7016	No	Washed out
440681	LAMB IRR DITCH	6	0.70254	Yes	
580939	WINDSOR DITCH	6	0.70349	Yes	
580767	MAYFLOWER DITCH	6	0.70443	Yes	
570675	UTTERBACK ENL COLO UTE D	6	0.70538	No	Removed, minimal use
580872	SOUTH SIDE DITCH	5.98	0.70632	Yes	
540558	READ WINSLOW DITCH	5.95	0.70725	No	Not on modeled tributary
440633	GRANDT DITCH	5.9	0.70818	No	Removed per Division 6 recommendation
580520	BARBER SEEP WASTE D	5.9	0.70911	No	Removed, minimal use
581084	ROSSI DITCH 1	5.9	0.71004	No	Removed, minimal use
580584	CHILTON DITCH	5.9	0.71097	No	Removed, minimal use
440857	BENNER DITCH	5.9	0.7119	No	Removed at basin meetings, minimal use
440585	CRYSTAL CK DITCH	5.9	0.71282	Yes	
580986	GUMPRECHT WILKINS SEEP 1	5.9	0.71375	No	Removed, minimal use
570535	ERWIN IRRIGATING DITCH	5.86	0.71467	Yes	
440720	MYERS DITCH NO 1	5.8	0.71559	No	Removed at basin meetings, included at Maybell
580574	C R BROWN MOFFAT COAL D	5.77	0.7165	Yes	
540592	WILSON DITCH	5.75	0.7174	Yes	
440635	GRIESER DITCH	5.75	0.71831	Yes	
580844	SAGE HEN DITCH	5.74	0.71921	Yes	
581027	MT WERNER BURGESS PL	5.733	0.72011	No	No longer used
580830	PRIEST DITCH	5.67	0.721	Yes	
440670	J W KELLOGG D 2	5.67	0.7219	Yes	
581074	ROSSI HIGHLINE DITCH	5.66	0.72279	Yes	
540556	PORTER SALISBURY DITCH	5.66	0.72368	No	Not on modeled tributary
580928	WHEELER BROS DITCH	5.6	0.72456	Yes	
580556	BRINKER CREEK DITCH	5.6	0.72544	Yes	
580850	SANDHOFER DITCH	5.56	0.72632	Yes	
570575	NOFSTGER ZEIGLER FEEDER	5.5	0.72718	No	Removed per Division 6 recommendation

Table 3.1

Yampa Basin Diversion Structures with Water Rights ≥ 5 cfs

WDID	Structure Name	Decree Amount (cfs)	Cumulative % of Total	Is Structure in Final Model?	Comments
440716	MULLEN DITCH	5.5	0.72805	Yes	
540510	BRIGHTON DITCH	5.5	0.72891	No	Removed, averages 0.7 cfs
580640	FIRST CHANCE DITCH	5.5	0.72978	Yes	
580809	OLD CABIN DITCH	5.4	0.73063	Yes	
581095	AULTMAN DITCH	5.4	0.73148	No	Removed, minimal use
581035	NORTH SIDE DITCH	5.4	0.73233	Yes	
580980	GABIOUD DITCH	5.39	0.73318	Yes	
581435	ANDERSON RES INLET	5.35	0.73402	No	Removed, small reservoir feeder
440704	MESA IRR DITCH	5.33	0.73486	No	Removed at basin meetings, washed out
570517	DAVID M CHAPMAN DITCH	5.32	0.73569	Yes	
440999	FLOYD BUTTS DITCH	5.31	0.73653	No	Removed at basin meetings, minimal use
540535	INDEPENDENT DITCH	5.3	0.73736	No	Removed, not active
580728	LARSON DITCH	5.2	0.73818	Yes	
540571	SLATER PARK DITCH NO 2	5.1	0.73898	Yes	
580678	HARRIS MILLER DITCH	5.02	0.73977	No	Washed out
440834	ROWLEY PUMP STATION	5	0.74056	No	Removed, averages 0.9 cfs
580664	GROUSE CREEK DITCH	5	0.74135	No	Removed, averages 1.5 cfs
441019	COOK DIVERSION	5	0.74214	No	Removed at basin meetings, minimal use
580985	GUMPRECHT WILKINS SEEP 2	5	0.74292	No	Removed, minimal use
440656	HULETT & TORRENCE D	5	0.74371	No	Removed, averages less than 5 cfs
581598	MILL CREEK DITCH	5	0.7445	No	Removed, no data
580583	CHARLES H KEMMER D	5	0.74528	Yes	
440761	SELLERS CROWELL DITCH	5	0.74607	No	Removed, averages 2.4 cfs
580811	OLIGARCHY DITCH	5	0.74686	Yes	
542077	MARY ANN D NO 2	5	0.74764	No	Not on modeled tributary
580566	BULL CREEK D	5	0.74843	Yes	
542091	MARY ANN D NO 1	5	0.74922	No	Not on modeled tributary
540549	MORGAN SLATER DITCH	5	0.75	Yes	
440715	MOUNTAIN MEADOWS D	5	0.75079	No	Removed at basin meetings, feeds pond
580725	LARAMORE DITCH	5	0.75158	No	Removed, averages 2.2 cfs
580891	STUCKEY PIPELINE	5	0.75237	No	Removed, minimal use
572083	DRY CREEK DIVERSION	5	0.75315	No	Removed, minimal use

Table 3.1

Yampa Basin Diversion Structures with Water Rights ≥ 5 cfs

WDID	Structure Name	Decree Amount (cfs)	Cumulative % of Total	Is Structure in Final Model?	Comments
440533	ANDERSON DITCH	5	0.75394	Yes	
440713	MORGAN DITCH	5	0.75473	No	Removed at basin meetings, minimal use
580782	MOODY DITCH	5	0.75551	Yes	
580886	STEES DITCH	5	0.7563	No	Removed, minimal use
440733	PETER UEHLEIN D	5	0.75709	No	Removed, averages 1.7 cfs
580540	BIJOU DITCH	5	0.75787	No	Removed, averages 1.5 cfs
580561	BRUMBACK DITCH	5	0.75866	Yes	
580922	WEISKOPF DITCH	5	0.75945	Yes	
584630	DOME CR DITCH	5	0.76023	Yes	Added under Phase IIIa, averages 2.5 cfs (below cutoff) but xmountain diversion
580797	NICHOLSON DITCH	5	0.76102	No	Removed, minimal use
580558	BROADBROOKS SEEPAGE D	5	0.76181	No	Removed, minimal use
580547	BOOR DITCH	5	0.7626	No	Removed, minimal use
580924	WELCH & MONSON D	5	0.76338	Yes	
442025	VALLEY PUMP	5	0.76417	No	Removed at basin meetings, minimal use
440695	MAYBELL MILL PIPELINE	2.228	0.8892	Yes	Added from initial watright run
990528	CHEYENNE CITY	120	-	Yes	Added to model Little Snake M&I depletion's
990533	WYOMING IRRIGATION	120	-	Yes	Added to model Little Snake irrigation diversions in WY
990534	WYOMING IRRIGATION	120	-	Yes	Added to model Little Snake irrigation diversions in WY
990535	WYOMING IRRIGATION	120	-	Yes	Added to model Little Snake irrigation diversions in WY
442214	WISE DITCH ALT. POINT	2	0.90966	Yes	Recently re-activated to serve lands

3.2. Basin Meeting Notes

A meeting with the Division 6 Engineer and staff was held on April 25, 1995. The main purpose of the meeting was to gain an understanding of the administration of water rights in the basin. In addition, the following key points were covered:

- Administration issues in each water district
- Irrigation practices
- Irrigation and municipal return flow locations
- Availability of diversion records
- Irrigated acreage estimates

In attendance at the meeting were the following:

- Ed Blank — Division 6 Engineer
- Kent Holt — Assistant Division 6 Engineer
- Elvis Iacovetto — Water Commissioner (District 58)
- Andi Schaffner — Water Commissioner (Districts 57 and 58)
- Walt Bohrer — Water Commissioner (District 44)
- Kathy Bauer — Assistant Commissioner (District 44)
- Ray Bennett — Division of Water Resources
- Markus Ritsch — Riverside Technology, Inc.
- George Fosha — W.W. Wheeler and Associates, Inc.
- Jim Hyre — W.W. Wheeler and Associates, Inc.

Prior to the meeting, George Fosha and Jim Hyre prepared maps (1:100,000 scale) of the Yampa River basin showing the locations of key structures (ditches and reservoirs) that are being proposed for inclusion in the Yampa Model. The locations of the structures were based primarily on the descriptions given in the water rights tabulation database. Also prior to the meeting, Markus Ritsch prepared a summary of the years in which there were available diversion records for the key structures. During the meeting, the group had access to the division's water rights and structures databases. The meeting proceeded in a general manner in which, working with the maps showing the key structures, the water commissioners would generally discuss the following:

- Administration issues in each Water District
- Irrigation practices
- Irrigation and municipal return flow locations
- Availability of diversion records
- Irrigated acreage estimates
- In the mid-1970's, Kent Holt developed a water rights administration model for the main stem of the Yampa River and the Elk River. (Information from this model was not incorporated into the CDSS effort.)
- Identified major water rights on the main stem and identified return flow locations.
- Structure locations and return flow locations were based on river miles.

- Also contained preliminary estimates of irrigated acreage.
- Kent believes the model reasonably reflects the physical operations on the river.

Interview with Elvis Iacovetto (District 58):

- Elvis provided shareholder entitlements for water in the Stillwater Ditch, Stillwater Reservoir No. 1 and Yamcolo Reservoir.
- Stillwater Ditch must be off by October. (This was not implemented because historical diversions were recorded in October.)
- Portion of Stillwater Ditch is used in the Colorado River basin. From shareholder list it is estimated about 68 percent in the Yampa Drainage and 32 percent in the Colorado drainage.
- Ditch delivers storage water from Stillwater No. 1, Yamcolo and Gardner Park reservoirs.

- Stillwater Reservoir No. 1:
- 1 share = 1 ac-ft.
- Shareholders can carry over no more than 40 percent of their entitlement (on September 30). (This was not implemented into the CDSS effort.)
- Model targets should be set to keep reservoir full when in priority.
- See list of individual sub-accounts in the reservoir.
- Leave outlet at constant rate during the summer; regulate at Yamcolo. (This was not implemented.)
- Reservoirs generally only get one chance to fill in spring runoff; therefore, essentially a one-fill rule is administered.
- 12 hour lag time from Stillwater Reservoir to Yamcolo Reservoir.
- River often dries up at the Nickell Ditch.
- Town of Yampa releases 2 cfs to keep stable streamflow.
- Ditch headgates are often set to keep a constant flow. When the direct rights are short, reservoir water is delivered.

- Yamcolo Reservoir:
- Louis Rossi leases his shares of Stagecoach Contract water to Duane Accord.
- Stagecoach Contract water is the most junior in Yamcolo.
- Yampa Reservoir is owned by the CDOW and is operated to keep full.

- Rams Horn Reservoir:
- Owned by one individual (Kirk Shiner).
- Good fishery; Not used much for irrigation.
- Coal Creek Ditch carries water transbasin to headwaters of Moody Creek.
- Re-diverted into Bayou and Moody ditches (owned by J. Deganahl).
- Return flows to the Ferguson Ditch (also owned by Deganahl).

- Brinker Creek.

- Finger Rock Pipelines. Non-consumptive for fish hatchery. (not modeled)

- Moore Park Creek (Elgin Ditch) (not modeled)
- Lives largely on return flows from Lindsey, Big Mesa and C.A. Leighton ditches.
- Elvis can dry up stream at the Fix Ditch. Return flow from Elgin can make a stream.
- Most of return flows from Buckingham Mandall, Mandall, Acton and Fix ditches go to Phillips Creek.
- Pennsylvania return flows below Town of Yampa.
- Bird and Nickel return flows above Egeria Ditch.

- Allen Basin Supply Ditch:
- Diverts from Mill Creek. Delivers transbasin to Allen Basin Reservoir.
- Not much water. Only diverts in spring runoff before direct flow rights are in.

- Boor Ditch is not used much. It is a small carrier ditch from So. Hunt Creek to Mill Creek above the Allen Basin Supply Ditch. (not modeled)

- Lafone Ditch is the last calling right on So. Hunt Creek.
- Collins Ditch and the Simon Ditch are the major rights on Middle Hunt
- Rossi No. 1 is higher on Middle Hunt Creek but is not used much. (not modeled)

- North Hunt Creek:
- The Sage Hen Ditch is above the N. Hunt Creek Ditch
- Return flows from High Mesa and Sage Hen are intercepted by N. Hunt Crk Ditch.

- Allen Basin Reservoir:
- Water delivered to Simon, Collins and Reservoir Ditch (a carrier ditch).
- Reservoir Ditch carries to Bull Ck. Ditch, Mill Creek Ditch and Lateral A Ditch.
- North Hunt Creek Ditch can dry up No. Hunt Creek; Collins can dry up Middle Hunt Creek and Lafone Ditches can dry up South Hunt Creek.
- Oakton Ditch gets a lot of return flow directly from tailwater out of Egeria Ditch.
- Union Ditch was inundated by Stagecoach Reservoir and is not used much except for Stagecoach mitigation plan.

- Stagecoach hydropower:
- Up to 115 cfs can be released for hydro. >115 cfs goes over spillway.
- Typically run at minimum 40 cfs for power generation. (This was not implemented.)

- Lake Catamount:
- Historically released up to 2,000 ac-ft in October to prevent icing problems at inlet. Slowly refill in the following spring. No longer do this practice. (This was not implemented.)

- Sarvis Ditch:
- No controlled diversion at top of basin divide. Poor records but are adjusted by water commissioner based on snowpack measurements.
- 1,000-2,000 acre-feet/year. Records will overstate diversion.
- Walton Creek Ditch irrigates everything from McKinnis Creek to the main stem
- Enterprise Ditch acreage does not include golf course (Hwy 131 – Hwy 40) (Golf course acreage not modeled.)
- Suttle Ditch irrigates both sides of river.
- Fish Creek Municipal Intake serves both the Mt. Werner Water and Sanitation District (WSD) and Steamboat.
- Structure ID 1027 – Burgess Creek Pipeline is the old Mt. Werner diversion.
- Steamboat Garden Ditch has not been used in over 15 years. No irrigated acreage left.
- Kent Holt indicated his opinion that the overall seasonal irrigation efficiency in the Yampa River basin is probably on the order of 15 -20 percent. For irrigation return flows, he estimates that up to 70 percent is surface runoff.

- Typical irrigation season in Yampa drainages:
- Bear River – Hunt Creek: Begins around May 1 to May 15; ends around end of July.
- Yampa River main stem: Begins around June 1; ends around mid-July.
- West of Hayden; First cutting of alfalfa around 3rd week of June: Second cutting in early August. Occasionally a third cutting.
- There is some late season irrigation after harvest (fall pasture). (not modeled)
- Most of the ditches and diversions downstream of Steamboat Springs do not have measuring devices. These structures are occasionally rated by Kent or the commissioners.

Interview with Andi Schaffner (Districts 57 & 58)
Water District 57

- Oak Creek:
- Rich Ditch is a carrier ditch from Trout Creek to Oak Creek. Treat as inflow to Oak Creek. These inflows benefit the Rossi, Oakdale and Alpha ditches. (Modeled as a transbasin diversion to Oak Creek.)
- Oak Creek Ditch is No. 1 priority (11 cfs); return flows mostly (80 percent) to Yampa River.
- Lyon Ditch No. 1 is senior right but only 1 cfs; Lyon No. 2 typically 3-5 cfs.
- To determine physical capacity of ditches, search diversions records for maximums.

- Trout Creek:
- Last Chance Ditch can carry water to Middle Creek (after irrigation season). (not modeled)
- Chapman (Orno) Ditch can regulate upper Trout Creek. It is senior to Rich and Last Chance. Its return flows are above the Koll Ditch.

- Fish Creek:
- Highland Ditch is controlling structure on W. Fish Creek.
- Williams Park Ditch (623) receives tailwater directly from the Highland Ditch (544).
- Gibraltar Ditch is all of north side of river down to Erwin Ditch. Last 10 years of diversion records are not too bad.
- Marshall Roberts ditch. Much surface returns directly to the Williams and Walker ditches (below headgate. Ten years ago, expanded acreage (+600 acres). The increased acreage is reflected in the division engineers' database.
- Shelton Ditch gets a lot of water from the Walker Ditch (tailwater).
- Neither the Cary or Brock get much tailwater directly from upstream ditches.
- The following structures have minimal use, no record or have washed out: West Side Ditch (612); JOK Ditch (549); Spencer (1034); Corliss (515); Sage Creek Ditch (585); Utterback Enlarge.(675); Nofstger (575); Emrich Feeder (533). Andi and Kent suggest leaving out of CDSS model. (These were not modeled.)

Water District 58

- Woodchuck Ditch: All irrigation is in Slate Creek drainage (Returns to Elk River). Woodchuck is the first right on Soda Creek.
- Soda Creek (868): treat as one user even though many individuals.
- Hot Springs Highline Ditch (11 cfs) return flows to Elk River.
- Kinney Ditch (717) return flows to James Wheeler (Tailwater). (not modeled)
- Oligarchy Ditch (811) irrigates approx. 115 acres.
- Steamboat Lake: leave full all of the time.
- Hoover Jacques Ditch: Much of return flows to Cottonwood Gulch. (Above Franz).
- Burnett Ditch return flows come into Sand Creek.
- Wither Ditch diverts less than 1 cfs even though decreed for 11.8 cfs. (not modeled)
- Felix Borghi Ditch has some fishery diversion in winter. This ditch is in West Elk.
- Steamboat Springs/Mt. Werner WWTP is just downstream of Duquette Ditch (near Steamboat II). Some land treatment. Talk to Gilbert Anderson.
- Because of non-use, poor records or diversions much less than 5 cfs, the following structures were recommended for removal from the CDSS: Fry System (653); Harris Miller (678); Look Waste Ditch (746); Look Seepage Ditch (743); Altman (1095); North-South Ditch (799); Gumprecht Wilkens Seep (986)Kernaghan (716); Metcalf (774); Stuckey (889/892); Bishop-Ratcliff (542);

Nicholson (797); Stees Ditch (Cow Creek); Sandelin (848); Chilton (584); Sandelin Storage (849). (These were not modeled.)

Interview with Walt Bohrer and Kathy Bauer

The interviews with the commissioners for District 44 were largely spent reviewing the maps showing the locations of the key structures, with the intent of understanding any unusual circumstances for each ditch, whether they were active or not used and to some extent the nature and extent of irrigated acreage. The following is a summary of the key points discussed:

- City of Craig uses the priority of the Deep Cut Ditch (8.29 cfs) and diverts the water at the Craig Water Supply Pipeline (581). Municipal wastewater returns above the intake to the Craig Station power plant. City no longer uses the diversion on Fortification Creek.
- Deep Cut Ditch records don't include diversions by city of Craig.
- Yampa Ditch is high on river bank. Cannot divert except during high water.
- M Ditch (691) irrigates only about 34 acres (see acreage database).
- Ellis & Kitchens Ditch (614) typically opens up around July 1.
- Starr Irrigation Ditch (770) diverts out of Elkhead Reservoir. Return flows occur above Smith Ditch (763).
- Mesa Irrigation Ditch (704) headgate washed out in 1984.
- Highline Mesa/Baker Ditch is now a pump. Fill missing diversion data with zero values.
- McDonald Ditch (698) is used to fill several small reservoirs. Approx. 200 acres of pasture.
- Yampa Valley Stockmans Ditch irrigates the meadows in the Big Bottom area.
- The Airline Ditch has several years of no pumping. It is owned by ColoWyo Coal Co.
- Egry Mesa Ditch (607) runs some water for a small hydro plant during the winter at least back to 1988? Approximately 2 cfs. Need to check diversion records.
- The location of the J.P. Morin Ditch needs correcting. (This was done.)
- The Harper Ditches #1 (644) and #2 (645) need to be added to the model (Waddle Creek). (These are modeled.)
- Return flows from the Averill Ditch (538) accrue to Stinking Gulch. (Stinking Gulch was not modeled.)
- Carrigan Averill Ditch (572) irrigates on west side of creek above road (54 ac.).
- Return flows from Hadden Base (638), Hart (812), Roby No. 1 (747), Roby No. 2 (748) all return to stream.
- Highland Ditch (651) is a transbasin ditch into Stinking Gulch, downstream of Iles Gulch. (not modeled)
- Return flows from Dennison Martin (593) accrue to Stinking Gulch. (Stinking Gulch was not modeled.)
- Martin Creek Ditch is a feeder for DD&E Reservoir and eventually is used to irrigate about 400 acres. (DD&E Reservoir was not modeled.)

- The DD Ferguson Ditch (587) is downstream of Wilson Ditch (509). Ferguson is on east side of stream; Wilson on the west side.
- DD&E is on east side of creek, downstream of Milk Creek No. 1 and irrigates about 600 acres.
- Milk Creek Ditch (706) can get reservoir water from Wilson Reservoir (Perch Pond). (not modeled)
- The Round Bottom ditches (749 and 751) are used for sporadic irrigation of pasture (206 acres).
- The 555 Ditch (555) and the Juniper Mtn. Tunnel should be modeled with a combined acreage of 348 acres (118 + 230). (not modeled)
- The Wise Ditch (2214) has only 2 cfs of transferred water but irrigates 178 acres. Probably pumps in range of 5 to 10 cfs. Consider assigning a junior water right.
- The Maybell Canal irrigates about 1,225 acres.
- The Myers Ditch (720) could be included with the Maybell Canal. Otherwise leave out of model. (not modeled)
- Maybell Mill right (695) now used for clean-up of old Maybell mill. There are no return flows from this right. Now at approximately 2.23 cfs.
- The Mock No. 3 Ditch (828) is active. Pick up the zero diversions.
- The Richardson Ditch (833) diversion records should be filled with zero diversions for years not used. (not modeled)
- The Vaughn Ditch (1122) should have zero diversions prior to 1985.
- The Morgan Ditch (851) has not been used for about 10 years. Started again in 1994. Estimated acreage is 200 acres. (not modeled)

After consideration of active use versus non-use, usable diversion headgates, amount of acreage irrigated and magnitude of diversions (much less than 5 cfs), Kent Holt and the water commissioners recommended that the following structures not be included in the Yampa Model.

- Van Tissel (2207)
- Yampa Ditch (516)
- Stuckey (772)
- Clapp Ditch (575)
- Grant Ditch (633)
- Benner Ditch (857)
- Sullivan Seep (776)
- Owen Carrigan (726)
- Collum No. 2 (579)

3.3. Wyoming Diversion Structure Information

Descriptions of major structures in the Little Snake basin in Wyoming are available at the website for Wyoming's State Water Plan. The Green River Basin Plan can be viewed at http://waterplan.state.wy.us/plan/green/green-plan.html. To access technical memos on diversion structures, click on:

"Green River Basin 2001 Water Plan"

"Technical Memoranda Table of Contents"

"Water Division 1, District 8" (under 'Diversions')

4. Yampa Basin Instream Flow Rights

The January, 2003 instream flow right tabulation for Division 6 shows there are 129 appropriations covering 551 stream miles in the Yampa River basin. To obtain a copy of the tabulation, visit the CWCB's website at www.cwcb.state.co.us, click on "Stream and Lake Protection," and then "Instream Flow and Natural Lake Level Water Rights Database."

5. Yampa Basin Modeling Efforts

5.1 YRBAS Model

The CDSS data collection effort called for review of the assumptions, databases, and results of prior modeling efforts in the Yampa River basin. This section summarizes the objectives, key modeling assumptions and results of recent water rights modeling efforts conducted by Hydrosphere Resource Consultants (Hydrosphere) for the Colorado River Water Conservation District (CRWCD) and the CWCB for the "Yampa River Basin – Alternatives Feasibility Study" (YRBAS). This study examined current and future water supply and water-based recreation needs in the Yampa River basin. It also evaluated the potential for establishing an instream flow right on the Yampa main stem using a portion of the CRWCD's conditional water rights decreed to the Juniper Project. The study focused on the potential for development of new storage facilities to meet existing and future water needs in the basin while enhancing a river regime conducive to the recovery of endangered fish species in the lower Yampa/Green Rivers. The Phase I Study was completed in March 1993 and recommended a near-term enlargement of the existing Elkhead Reservoir and the long-term enlargement of Stagecoach Reservoir. The new storage would serve as an augmentation source for future uses by junior water rights in the basin without impacting the instream flows available under the Juniper water rights. In March 1995, a Phase II Study was completed and provided additional detailed analyses of the simulated operations of the recommended alternative to enlarge Elkhead Reservoir. This memorandum provides a review of the procedures and assumptions adopted for the modeling efforts for both phases of the study, and discusses the relevance of the modeling work to the current efforts of the CDSS.

For the YRBAS, a network flow modeling system developed by Hydrosphere, known as the Central Resource Allocation Model (CRAM), was utilized. The network for this model consists of a system of nodes and arcs. The nodes typically represent points of inflow, outflow and junctions of flow in the stream system network, while the arcs connect the nodes and typically represent paths through which water must flow, subject to certain prescribed constraints. The flow through any arc is assigned a positive or negative cost, which in water rights modeling generally relates to the priority of a water right. The solution of the network is the set of arc flows that produces the minimum total cost (or maximum value) for the entire network. As such the network solution employed by the CRAM model can be considered a form of optimization model. For CDSS, the model StateMod has been adopted for the Yampa Model. This model can be considered as an allocation model that distributes available water to the demands in the network in strict accordance with a described set of priorities (water rights). As a result of fundamental differences in the two modeling approaches, there is little opportunity to directly import data files and assumptions related to complex administrative issues from the CRAM platform to the StateMod platform.

In the YRBAS, 25 USGS stream gages were identified to assist in estimating inflows to different locations in the model. The majority of these gages were also used in the CDSS,

although some of the gages were excluded because of insufficient data during the CDSS study period, 1975-1991. For the YRBAS, gaps in the flow data were filled using regression equations relating tributary area, average elevation and basin aspect. Some of the regressions were used to predict annual flows which were then distributed into monthly estimates by comparison to monthly patterns for recorded gages. For CDSS, regression equations were also developed to fill data gaps, but were based on regressions similar to those recently developed for the CWCB by Leonard Rice Consulting Water Engineers, Inc.. In the majority of the cases, the regressions for YRBAS and the CDSS were both made against similar long term gage records and are believed to be consistent with each other. We are not aware of substantial differences in the resulting gage data used for inflows in the two models.

In the YRBAS, the majority of the existing uses in the basin (and the resulting stream depletions) are implicitly modeled in the historical hydrology as reflected in the USGS gage records. As such the effects of these water rights are left in the gage. In particular, existing water rights that are senior to the 1954 priority of the Juniper Project are implicitly modeled, with the following exceptions: 1) the senior agricultural water rights were given a demand adjustment to reflect potential dry-year increases in diversion requirements (this adjustment was made for 10 years out of the 53-year study period); 2) senior municipal and industrial water rights were given a demand adjustment to reflect current levels of use over the course of the entire study period (for example the city of Craig municipal demand needed to be adjusted upward in earlier years of the study period in order to simulate current municipal demands over the entire study period. Likewise, the effects of the industrial diversions at Hayden and Craig Stations were adjusted to reflect use over the entire 53-year study period. For simplification in the model, all of the existing senior demands were aggregated into only 26 demand nodes in the model. For example, all agricultural demands above Stagecoach Reservoir were modeled as one aggregated demand. It is also noted that existing seniors on small tributaries are assumed to included in the aggregation with water rights on the main stem. This assumption may be warranted, provided that there are no shortages on the small tributaries.

In the YRBAS, existing water rights that are junior to the 1954 Juniper decrees are explicitly modeled, although they are aggregated into only six model nodes. In order to explicitly model these existing juniors, it was necessary to back out the historical depletions attributable to these rights from the historical gaged data. Historical depletions were provided by the Division 6 engineer and are presumably based on estimates of historical irrigated acreage and estimates of crop consumptive use. Diversions at each model node, whether existing senior or junior, are estimated as a function of depletion and an assumed system efficiency. By simulating diversions, it is also possible to estimate the quantity of return flows.

Because of the planning nature of the YRBAS, the CRAM network model also includes provisions for future demands in the basin. These are based on projections of future growth in municipal demands, potential construction of new thermal electric power generating units and some minimal level of increased agricultural uses. In the CDSS, the majority of the active structures are explicitly modeled, specifically all structures which cumulatively represent 75 percent of all absolute direct flow decrees in the basin. In the Yampa River basin, this is equivalent to a representation of all structures that have decrees in excess of five

cfs. As such, only the very small (and less depletive) water rights are assumed to be left in the gage. Demands for the included water rights are based on actual historical diversion data and depletions will be estimated by assuming system efficiencies. The total consumptive use will be verified during simulation operations by using estimates of historically irrigated acreage, estimates of crop consumptive irrigation requirement and estimates of irrigation efficiencies (this verification is similar to the procedures used in the YRBAS model). Because of the inclusion of more structures in the Yampa Model, it is believed that the demands in the basin are more clearly defined, in comparison to leaving the majority of the rights in the gage as in the YRBAS.

The Yampa Model does not currently contain any provisions for future projected growth and increased water demands. However, since it includes many more explicitly modeled nodes, it would be relatively straightforward to add additional demands to any existing structure or add new demand nodes in the network.

In the YRBAS, a number of the inflow nodes for the model (approximately 15) are included to reflect return flows from existing and future basin demands. These are modeled as occurring either in the same monthly time-step (municipal diversions and return flows) or are lagged over a one to four month period (delayed timing pattern for subsurface irrigation return flows). For the latter, a set of lag factors are specified which are then applied against the amount of water delivered into a given node. Uses at the Hayden and Craig power plants are assumed to be 100 percent consumptive.

In CDSS, a return flow pattern is assigned to every structure included in the model and follows the same general timing pattern used in the YRBAS (typically a one to four month lag for irrigation return flows). In addition, the location of those return flows has been determined with respect to each downstream ditch structure that could potentially benefit from returns from upstream structures. The latter was accomplished through detailed analysis of irrigated acreage maps provided by the division engineer. Because many more structures are modeled in CDSS, it is believed that the return flow patterns and locations are more definitive than those in the YRBAS.

The YRBAS essentially models three existing reservoir: Stagecoach Reservoir, Steamboat Lake, and Elkhead Reservoir, the reservoirs that were the main focus of evaluation for potential enlargements and or changed operation to increase yield. Six other reservoirs in the basin were assigned a node in the CRAM model, but are turned off in the model. Smaller reservoirs are assumed to have a negligible effect on the flows in the river because of their small size and/or method of operation.

For the larger reservoirs, the individual sub-accounts are connected only to aggregated demands, particularly in the case of irrigation water. This is consistent with the overall approach to aggregate the majority of the irrigation rights. Storage and releases from reservoirs are driven by assignment of priorities relative to other direct flow demands in the network. In general, releases are made if demands are unsatisfied by diversions of river flow on a direct basis. In the CRAM allocation model, the storage, releases and accounting of storage within sub-accounts in the reservoirs (ownerships, water right priorities, etc.) are

represented by a complex series of arcs connecting the storage to the river flows and to the direct flow nodes which have access to storage.

Currently the Yampa Model includes detailed monthly operation of ten reservoirs. Numerous sub-accounts in each reservoir (where applicable) have been defined to specifically connect a reservoir sub-account to a ditch structure entitled to use reservoir water. Because of the number of reservoirs and explicitly modeled sub-accounts, it is believed that there is more specific definition of the Yampa River basin reservoirs in the Yampa Model.

It is clear that the objectives of the YRBAS modeling efforts and those of the CDSS are sufficiently different to explain the principal differences in the two modeling approaches, particularly as it relates to the number of water right structures that are being explicitly modeled in the CDSS and the more intensive focus on future development scenarios and reservoir storage options being addressed in the YRBAS. Accordingly, assumptions and data requirements for the two models vary substantially. There are a number of assumptions, described in the documentation for the YRBAS, that differ from those included in the CDSS. These are briefly discussed below:

- The YRBAS does not specifically model irrigation rights above Stagecoach Reservoir. From interviews with the division engineer, it appears that this is one of the few areas in the Yampa River basin that requires administration and may, from time to time be water short. Accordingly, it is important for the CDSS to model the upper reaches of the Yampa River in detail rather than an aggregated demand.

- The cumulative water rights at the Craig Station power plant are in excess of the 90.63 cfs described in the YRBAS documentation, if the water rights for the Synthetic Products Ditch are included. The latter is significant since it is senior to the Juniper water rights. There are also certain diversion limitations on some of the direct flow rights, based on conditions imposed as part of the transfer proceedings. We agree with the YRBAS in regard to the actual diversion demands at Craig Station.

- The YRBAS documentation implies that the industrial water in Steamboat Lake (5,000 acre-feet) can only be used at the Hayden Station after the industrial storage in Stagecoach Reservoir is depleted. We are not aware of any such limitations. Hayden Station does not have access to storage in Stagecoach Reservoir.

- We believe the sub-accounts in Stagecoach Reservoir are misrepresented in the YRBAS. The industrial account in Stagecoach Reservoir now owned by Tri-State Generation and Transmission Association (Tri-State) contains a total of 11,000 acre-feet (7,000 acre-feet attributable to the Stagecoach water rights and 4,000 attributable to the exchange with Yamcolo Reservoir). Storage in Stagecoach Reservoir is now allocated as 11,000 acre-feet to Tri-State; 2,000 acre-feet to existing municipal contracts, 2,000 to unallocated M & I contracts and 18,275 acre-feet to recreation and dead storage.

- It is our understanding that because of limitations with the hydro-generating equipment, the UYWCD generally operates at a minimum release of 40 cfs during the winter months.

- Because of a recent court decision, the 3,300 acre-feet of storage in the surcharge capacity of Steamboat Lake cannot be specifically released for instream flow uses, as described in the YRBAS documentation.

- The city of Craig now owns the water storage formerly owned by the CDOW in Elkhead Reservoir. Based on recent capacity information, it is believed that the Yampa Participants (Craig Station) may now own approximately 8,754 acre-feet in Elkhead rather than the 8,310 acre-feet referenced in the YRBAS documentation.

- The YRBAS documentation refers to 50 percent of the Stagecoach water exchanged to Yamcolo Reservoir as being delivered out-of-basin to the Colorado River drainage. According to ownership information, about 90 percent of this Stagecoach Contract water is used in the Yampa drainage, with only 10 percent being used in the Colorado basin.

- The YRBAS assumes a reservoir administration date of April 1, the point of lowest storage during the year. Currently the Yampa Model assumes a November 1 administration date. This should be further investigated.

- It is our opinion that the potential yield of the Four Counties water rights at Stagecoach Reservoir could be greater than 4,595 acre-feet per year, as indicated in the YRBAS documentation. Even though the potential yield is greater, this will not make a significant difference in the operation of the reservoir.

- The objective of the YRBAS operation model is essentially to develop a tool to evaluate reservoir storage options and means to enhance the availability of water for downstream instream flows on the Yampa River without causing injury to existing and projected future uses. The assumptions and data requirements for this objective are somewhat more generalized that the assumptions required for development of the Yampa Model.

We are unable to identify any specific data or administrative policy procedures that have been developed for the YRBAS that could be directly ported to the Yampa Model, given the different objectives and focus of the two models. However, we found the YRBAS documentation and discussion to be very helpful in developing an understanding of many of the existing water rights operations and administrative practices (although we have taken exception to some of the assumptions). The documentation was also helpful in understanding some of the policy decisions that are facing the Yampa River basin in the near future.

5.2 Green River Basin Plan – Little Snake River Spreadsheet Model

The State of Wyoming undertook a statewide water planning process in 1999, producing the Green River Basin Plan as its first major basin plan in 2001. The final plan report includes a Basin Use Profile, a characterization of current water uses by sector; Available Surface Water and Groundwater Determination, an investigation of hydrology which involved developing spreadsheet models for the four major sub-basins of the Green River, one of which was the Little Snake; Demand Projections, an economically based estimate of future needs by sector; and discussion of Future Use Opportunities, the product of user meetings to identify potential projects and enhancements of the water supply, along with a review of institutional considerations.

The Little Snake spreadsheet model comprised three separate spreadsheets with different hydrologic and demand input, representing conditions under Normal, Wet, and Dry states of the basin. Each spreadsheet shows one twelve-month sequence, but the input for the model is based on historical data from the Normal, Wet, or Dry years within the period 1971 through 1998. This underlying data, including streamflow, diversions, crop demand, and historical efficiency, has been incorporated in the Wyoming portion of the CDSS model of the Little Snake River. Much of the data and details are not contained in the final Basin Plan report, but in technical memoranda produced as part of the Green River Basin Plan. These are available at Wyoming's website for the Green River basin plan, http://waterplan.state.wy.us/plan/green/green-plan.html

Specific information from the Green River Basin Plan, on which CDSS Yampa model input has been based, includes the following:

- Irrigated acreage, for two individual ditches, and for sub-tributary aggregations of ditches
- Crop irrigation requirement based on climate data and regional crop mix was available for Normal, Wet, and Dry years; each year within 1971-1998 was designated as Normal, Wet, or Dry, and so a time series of irrigation water requirements by model structure could be developed for those years
- Monthly historical diversions for First Mesa and Westside Canals, and the Cheyenne diversion project
- Normal year monthly efficiencies for First Mesa and Westside Canals
- Average monthly depletions for municipalities of Baggs and Dixon, and average monthly efficiencies for these diversions
- Maximum efficiency for irrigation structures